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ROENTGENOLOGICAL MANIFESTATIONS OF PRIMARY PULMONARY COCCIDIOIDOMYCOSIS*

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THE purpose of this presentation is to consider the characteristic roentgen features as observed in a study of 60 cases of primary coccidioidomycosis. Twelve cases, which demonstrated a severe and extensive form of pulmonary involvement, are particularly emphasized.

HISTORICAL AND CLINICAL BACKGROUND

Coccidioidal granuloma has been known as a chronic mycotic infection since the original descriptions by Posadas and Wernicke[12] in South America (1892), Rixford[9] in California (1894) and Ophüls and Moffit[7] (1900). About 744 cases[10] of this disease have been reported up to 1942. Dickson[4] in 1937 suggested the term "coccidioidomycosis" for this condition and called attention to an initial or primary stage, which he identified as being similar to an illness observed in the San Joaquin Valley of California and there known as "valley fever" or "desert fever." He further differentiated this early phase from the granulomatous or secondary stage of this disease.

The mode of infection is usually by inhalation of the chlamydospores of the fungus, *Coccidioides immitis*. This organism, which is endemic primarily in California and to a lesser extent in Arizona and Texas, consists fundamentally of two forms: a vegetative phase which exists in nature, and a parasitic spore which is found in the tissues of the host. The organism is not transmissible from man to man.

Clinically, primary coccidioidomycosis is manifest as an upper respiratory or mild bronchopneumonic illness with cough, chest pain, fever, erythema nodosum and positive pulmonary roentgen findings. After a mild and self-limited course over a period of three to six weeks, the patient usually makes a complete recovery.

In some cases the secondary stage of the disease follows. This can be protracted over many years with severe localizing skin and bone lesions or it can be rapidly fulminating in character, with a course of but a few weeks and with a terminal miliary or meningeal picture. The mortality in the chronic stage is estimated at about 50 per cent as compared to the negligible death rate in the initial stage.

* Analysis of Pathological Features by Captain W. B. Chamberlin, Jr., Medical Corps, Army of the United States.

The relation between the primary and secondary forms is considered to depend chiefly on the effects established within the host by a potent invading organism, as countered by the reaction of a constitutional and natural immunity. In instances where the inherent resistance is low, as among individuals entering an endemic area for the first time, or as among the dark-skinned races (prominent examples of which are the Negro, Mexican and Filipino) progress to the granulomatous stage may follow by a metatastic and hematogenous spread from the primary (usually) pulmonary focus.

When the primary infection becomes well walled off by the host,[11] the only residual evidence may be a positive coccidioidin skin test. This skin test is an allergic manifestation which is usually established about four weeks following exposure to the organism—and remains so for a fairly long period of time; in the San Joaquin Valley this duration has been estimated as about twenty years. Once a patient is allergized, an external reinfection does not occur. When coccidioidal granuloma follows, it does so only as an endogenous reinfection.

Diagnosis of this disease is usually determined by a consideration of the following: a history of exposure in an endemic area, clinical manifestations including erythema nodosum and eosinophilia, associated roentgenologic features, positive coccidioidin (1:100) skin test, positive complement fixation and precipitin tests.* Final diagnosis can be based only on the isolation of the spores from sputum by culture.

ROENTGENOLOGICAL BACKGROUND

The pulmonary manifestations of primary coccidioidomycosis have become roentgenologically significant within recent years. Reports by Carter,[2] Powers and Starks,[8] Winn,[13] Colburn,[3] Farness,[5] Schultze,[10] and Smith,[11] indicate that this disease produces a fairly well defined and consistent roentgen pattern, which, together with the history of exposure and the clinical features, permits early consideration of this configuration as a diagnostic roentgen entity.

Carter describes peribronchial thickening and mottling, partial and complete consolidation, mediastinal and hilar lymphadenopathy, pleural involvement and cavitation. In the secondary or granulomatous stage, he noted pulmonary appearances similar to those seen in the primary stage. These apparently represented progress of the lesions to chronicity. In addition, a mediastinal mass was noted in 50 per cent of cases and miliary pulmonary dissemination in over 30 per cent. The characteristic features of the secondary stage were the association of extrapulmonary manifestations. In 50 cases, Carter recorded ninety destructive bone lesions.

Powers and Starks have observed solitary lesions and bilateral nodular infiltrations. These latter went on to cavity formations which subsequently cleared. Hilar adenopathy was not prominent in their series. Winn described 13 cases of cavity formation in this disease.

Farness described an acute miliary process, similar to miliary tuberculosis, in a twenty-three year old female. This patient, shortly after childbirth, developed high and septic fever. Roentgen examination showed a fine, diffuse, infiltrative process bilaterally. Two weeks later, both lungs showed miliary seedings. On autopsy, coccidioidal spherules were recovered from the lungs. This overwhelming type of infection is of clinical and roentgenological importance, since it demonstrates how a poor resistance to this disease may produce an extensive primary pulmonary involvement which may be closely followed by a miliary disseminated coccidioidal process.

ANALYSIS OF CASES: ROENTGENOLOGICAL CLASSIFICATION

All of our patients were Army personnel from the Southern California and Arizona

* The complement fixation and precipitin tests in most of the cases in this series were done by Dr. C. E. Smith, Stanford University Medical School; the remainder (precipitin tests only) by an Army medical laboratory.

Desert areas. The greatest number had never previously lived in or travelled through these regions. Twenty-five (41.6 per cent) were Negroes; 1 patient was Indian and 1 was Mexican. The remainder (45 per cent) were white. There were 2 females in this series. Forty-seven (78 per cent) were in the third decade.

Of the clinical and laboratory manifestations, cough, chest pain and fever were present in 75 per cent of cases; erythema nodosum in 30 per cent; eosinophilia in 25 per cent. Positive coccidioidin skin test (1:100) was present in 80 per cent; positive serology (complement fixation and precipitin tests) in 86 per cent. In 6.6 per cent the sputum was positive for endospores.

Positive roentgen findings were found in 85 per cent of cases. The pulmonary features permitted the following classification:

(1) *The Nodular Lesion*	
a. Single or multiple	22%
b. Unilateral or bilateral	
(2) *Peribronchial Infiltration*	22.5%
a. Without marked hilar enlargement	(6%)
b. With associated hilar adentis	(16.5%)
(3) *Confluent Consolidations*	
a. Moderate or extensive.	20%
b. Bronchonpeumonic or lobar	
(4) *Hilar Lymphadenopathy*	24.5%
a. With slight peribronchial infiltration	(8%)
b. With marked peribronchial infiltration	(16.5%)
(5) *Pleural Involvement*	
a. Pleural effusion	5%
b. Adhesive pleuritis	
(6) *Cavity Formation*	5%
(7) *Bilateral Nodular (Local) Dissemination*	20%

(Note: 2b and 4b are identical groups)

The Nodular Lesion. So called because of the presence of an isolated and spherical shadow as the most prominent feature on roentgen examination. Microscopically, this structure closely resembles a tubercle. Coccidioidal spores are usually seen in a focal area of necrosis. Giant cells, mononuclear cells and granulation tissue are located peripherally. This nodular lesion was noted in 22 per cent of cases. The nodule is commonly seen at the apex, base, or the periphery of the pulmonary field. It may be unilateral or bilateral (Fig. 1); it may be of slight density or may stand out firmly and prominently. The borders of the nodule may be hazy and irregular because of peripheral inflammatory reaction or may be sharply delimited because of early fibrosis. The size may vary from 5 mm. to 2.5 cm. in diameter. The nodule may clear rapidly and completely within a few weeks or may persist for many months. In this latter form, the lesion may contract only partially form a firm fibrous capsule and persist as an incompletely resolved focus. None of the nodules in this series underwent cavity formation. No calcifications were noted, but these cases were followed for only a limited period of time. When the nodule appears in the upper lobes, reinfection tuberculosis must be differentiated. Pulmonary carcinoma of the alveolar or of the secondary metastatic types, neurofibroma and ganglion neuroma, neoplasm from the chest wall and pleura reflected onto the pulmonary fields may all produce similar appearances. The inflammatory nodules will show rapid change, variation in density and the association of fibrosis. The tumors will frequently have a lobulated outline, may show no change on serial study. The neurofibroma will be located posteriorly in the lateral view.

Peribronchial Infiltration. Subsequent to the parenchymal nodal implant, a productive type cellular inflammatory reaction takes place in the peribronchial and perivascular lymphatic and interstitial tissues. This is shown in the roentgenogram as thickening and confluence of the hilar and parenchymal markings, which assume a characteristic stippling or mottling. Peribronchial infiltration was noted in 22.5 per cent of cases. This process is frequently seen at the parahilar and basal regions, usually on the right side. When the apex is involved reinfection tuberculosis, again, is strongly simulated. These parenchymal shadows may be associated with nodular lesions and hilar glandular swelling (Fig. 2) or they may be seen independently. Resolution may take place within a few weeks in many cases; in others, clearing may take place

over an appreciably long period of time.

Confluent Consolidations. Extension of the inflammatory process from the smaller and middle-sized bronchi to the terminal bronchioles and the alveolar walls, with associated productive and exudative response, produces demonstrable isolated or confluent areas of pulmonary consolidation. These may be of bronchopneumonic or of lobar distribution. Progression and fusion of the nodular lesions combined with peripheral exudative reaction also may contribute to this appearance. Consolidation was observed in 20 per cent of the cases. The pneumonic consolidations in this disease are frequently characterized by their slow resolution. In some cases, clearing may take place after several weeks (Fig. 3). In others, there may be little change over a period of several months. Pleural effusion may be associated. The pneumonic form of tuberculosis and bronchogenic carcinoma may simulate this appearance closely. Differentiation may be possible only after study of the associated clinical evidence and over a prolonged period of time.

Hilar Adenopathy. The tracheobronchial and bronchopulmonary glands frequently become involved as a hilar lymphadenitis. This was noted as a fairly pure form in 8 per cent of cases, and together with moderate peribronchial infiltration in 24.5 per cent. The adenopathy may be associated with a parenchymal nodular or exudative focus and with lymphangitic streaks radiating from the initial lesions to the hilum. These three components parallel closely the characteristic roentgen appearance of childhood tuberculosis. Depending upon the

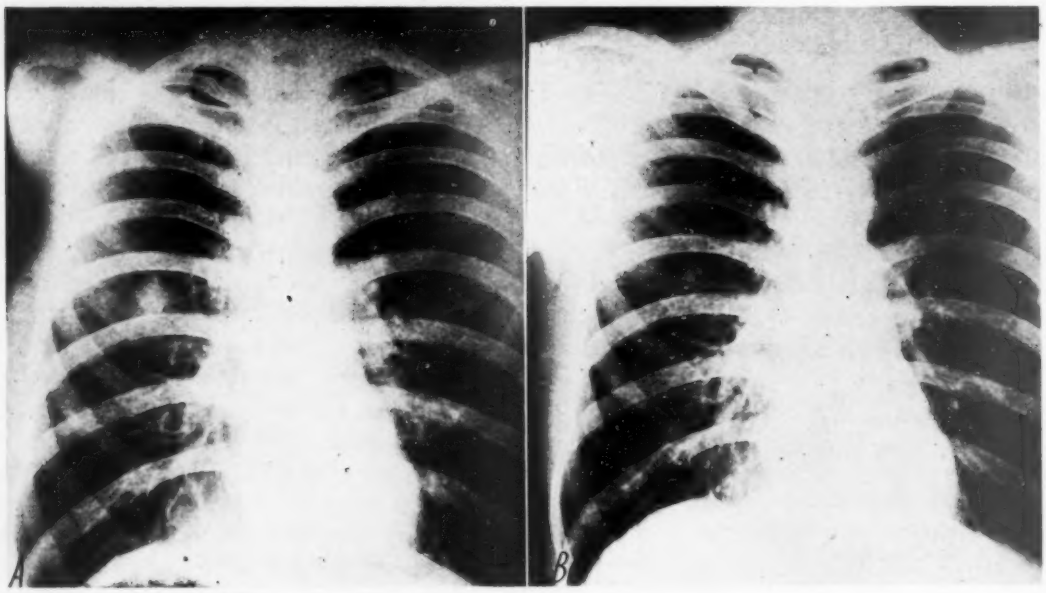

FIG. 1. *The Nodular Lesion. History and Clinical Features:* White, male, aged 30; had never previously been in California or Arizona. Admitted on October 26, 1943, with chest pain, cough, malaise and mild fever. *Coccidioides* (1:100) skin test was positive. Eosinophiles 13 per cent; sedimentation rate 26 mm. Complement fixation test strongly positive.

Roentgen Findings: (*A*) November 1, 1943. Roentgenogram shows a 2 cm., single, homogeneous nodule in the right mid-pulmonary field; edges are well defined. There is associated peribronchial thickening and haziness at the right cardiophrenic angle. Note the smaller sharply circumscribed nodule of slight density at the periphery of the left mid-pulmonary field. (*B*) December 27, 1943, shows beginning and partial clearing of the previously described nodule in the right mid-pulmonary field. The right cardiophrenic angle has cleared. The smaller nodule on the left is still present.

Disposition: Return to duty.

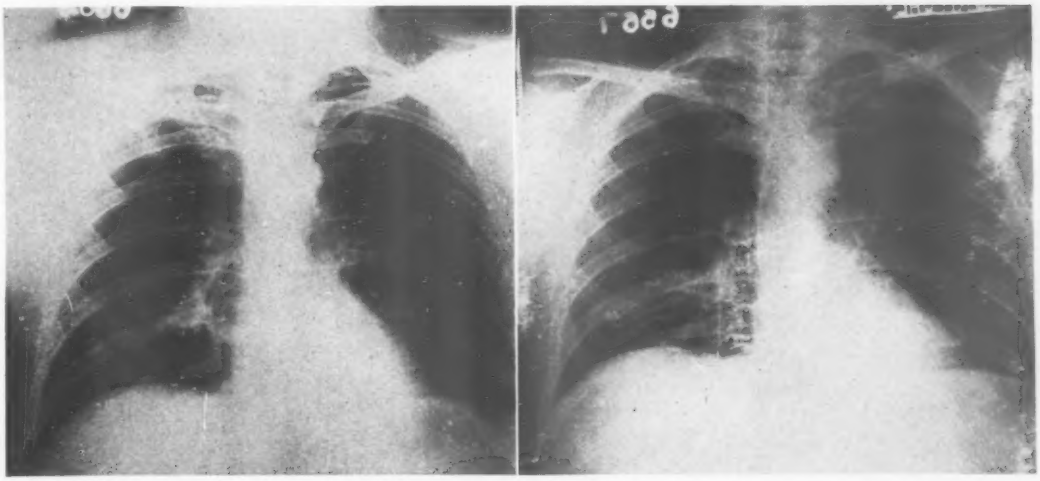

Fig. 2. *This case demonstrates a combination of bilateral nodulation and peribronchial infiltration. History and Clinical Features:* White, male, aged forty-five; was located in Southern California Desert from July to December, 1943. Admitted December 19, 1943, with cough, chest pain, malaise and mild fever. Positive *Coccidioides* (1:100) skin test. Sputum examination was positive for endospores.

Roentgen Findings: (*A*) December 14, 1944, shows a nodular infiltration, 1.5 cm., irregular in outline, situated in the left mid-pulmonary field. Circumscribed, sharply delimited nodule, 1 cm. in diameter, situated at the right subapical region and another similar lesion at the right base. There is present an associated right parahilar and basal peribronchial infiltration. (*B*) January 27, 1944. Five weeks later. There is now complete clearing of the previously described lesions. Slight residual infiltrations at the left midpulmonic field and at the right base are still present.

Disposition: Returned to duty.

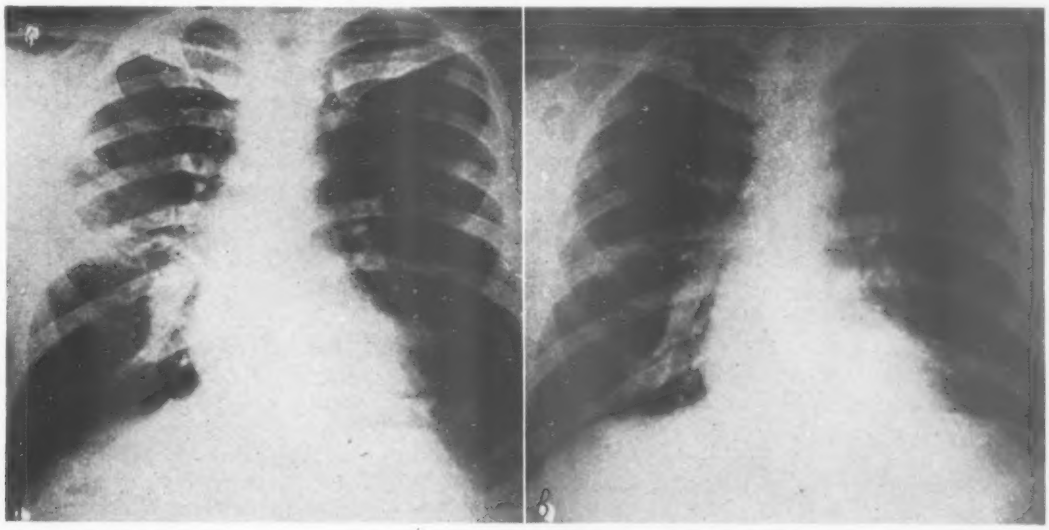

Fig. 3. *Partial Pneumonic Consolidation. History and Clinical Features:* White, male, aged nineteen; in Southern California Desert from August to November, 1943. Admitted in November with chest pain, cough, malaise, mild fever and erythema nodosum. Sedimentation rate 30 mm. Positive *Coccidioides* skin test (1:100). Complement fixation and precipitin tests were both strongly positive.

Roentgen Findings: (*A*) November 23, 1943, shows an area of pneumonic consolidation involving the base of the right upper lobe. (*B*) January 4, 1944, shows definite clearing, but a residual patch of consolidation is still present. Condition is that of a slowly resolving pneumonia.

Ultimate Disposition: Returned to duty.

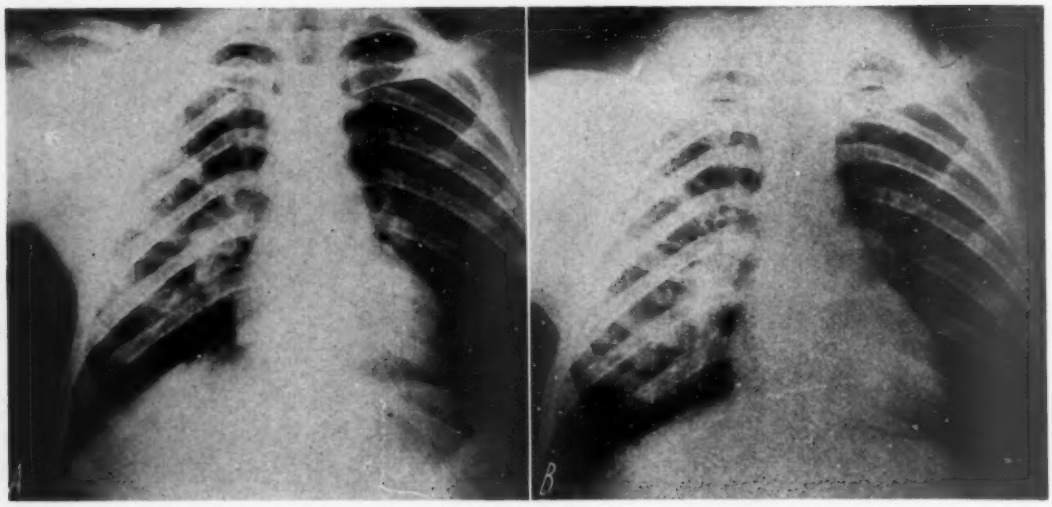

FIG. 4. *Hilar Adenopathy. History and Clinical Features:* Negro, male, aged twenty-two, in California Desert from July to November, 1943. Admitted in November with cough, chest pain, malaise, mild fever and erythema nodosum. Sedimentation rate 61 mm. Positive (1:100) skin test. Complement fixation and precipitin tests were both positive.

Roentgen findings: (*A*) November 16, 1943, shows a moderate lymphadenitis involving the right hilar nodes. In the lower axillary portion of the right pulmonary field, there is seen a hazy, irregular infiltration of slight density and about 1.5 cm. in diameter. (*B*) On November 29, 1943, about three weeks later, there is seen beginning resolution of the right hilar enlargement. The slight density at the peripheral portion of the lower right pulmonary field is still present.

Ultimate Disposition: Returned to duty.

extent and severity of the disease, there may be gradual clearing (Fig. 4); or persistence of an enlarged, fibrotic and distorted hilum may be observed over several months (Fig. 5). This latter form may simulate the lymphoblastoma, the hilar form of bronchogenic carcinoma, sarcoidosis and hilar tuberculosis.

Pleural Effusion. The pleural inflammation may closely resemble the effusion of tuberculous etiology in both character and course. It may clear after a relatively short interval or may continue for a prolonged period. Pleural effusion was noted in 3 of our cases as an accompanying manifestation to a parenchymal initial focus. These effusions cleared rapidly and completely (Fig. 6).

FIG. 5. *Hilar Adenopathy; Associated Peribronchial Infiltration. History and Clinical Features:* Negro, male, aged forty-seven; in Southern California Desert from July to December, 1943. Admitted December 20, 1943, with cough, fever, chest pain. Sedimentation rate 47 mm. Eosinophiles 25 per cent. Positive *Coccidioides* (1:100) skin test. Complement fixation and precipitin tests were both strongly positive.

Roentgen Findings: January 28, 1944, shows severe right hilar lymphadenitis with associated peribronchial parahilar and basal infiltration. Slight peribronchial infiltration, left base. On February 26, 1944, about one month later, there was practically no change in the previously described appearances.

Cavity Formation. Cavities were noted in 3 of our cases. In 2 cases, the significant feature was the subsequent clearing after about a period of a month. The cavities were both thin walled and showed associated peripheral parenchymal reaction. In 1 case, which is described later in detail, a large cavity was surrounded by pneumonic consolidation and was considered to be primarily of tuberculous etiology. Emphysematous blebs and lung abscess may give similar appearances and necessitate differentiation from cavities in this disease. The coccidioidomycotic cavity is usually differentiated from its tuberculous counterpart by persistently negative sputa on repeated examinations.

Although the extent and distribution of the preceding roentgen appearances are rather widespread and are out of proportion to the mildness of the clinical course, they are to be considered as representing the mild or moderate roentgen form of this disease since, in most instances, resolution takes place within a period of about six to eight weeks and usually leaves but slight residuum. However, the possibility of generalized dissemination must always be considered, especially in these primary stage lesions which fail to clear and which assume a protracted course. Smith[11] describes such a picture in 2 Filipino patients. In both cases, the disease progressed to coccidioidal dissemination. In each, the course was rapidly fulminating and fatal.

The roentgenological groups may frequently appear in combined form. Nodulation, exudation, pleural effusion and cavitation may all be present during the course of the primary disease and may produce a rather bizarre pulmonary picture. However, the individual factors contributing to

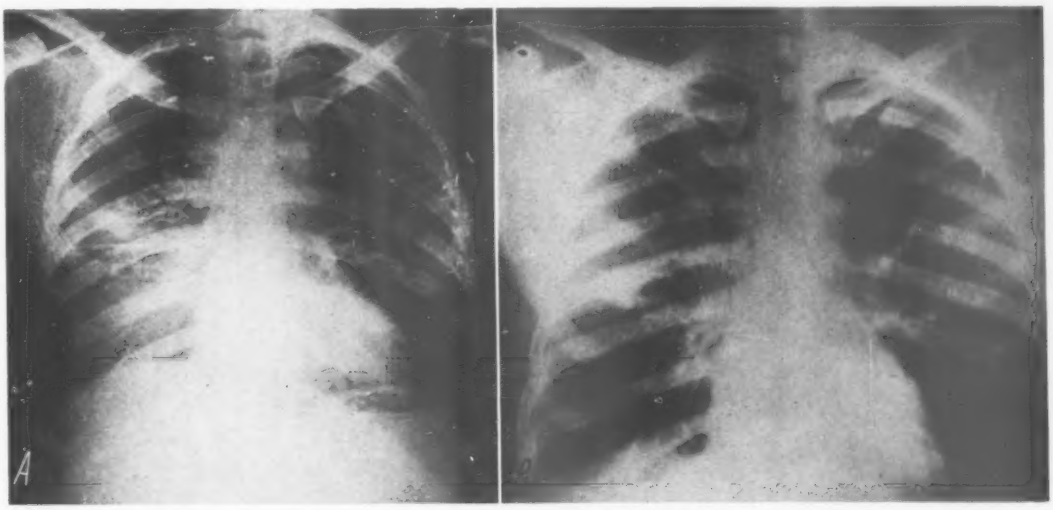

Fig. 6. *This case represents a sequence of pulmonary infiltration, pleural effusion and cavity formation. History and Clinical Features:* Negro, male, aged thirty-eight, in Southern California Desert from July until December, 1943, with cough, fever, chest pain. Sedimentation rate 55 mm. Positive *Coccidioides* (1:100) skin test. Complement fixation and precipitin tests were both strongly positive.

Roentgen findings: On December 31, 1943, a 1.5 cm. nodule was observed at the base of the right upper lobe. The right hilum was mildly accentuated. The transverse interlobar fissure was thickened. (*A*) January 15, 1944, shows a pleural effusion at the right base. A 2 cm. cavity is seen in the region of the right middle lobe. Follow up films showed progress of the effusion. (*B*) February 14, 1944, shows partial resolution of the previously described inflammatory processes. The right-sided pleural effusion shows noticeable clearing. Residual pleurisy is still present. The nodule at the base of the right upper lobe is still seen. The previously described cavity is no longer prominent. There is an associated peribronchial thickening at the right base.

the combined pathological picture may easily be discerned on the roentgen examination. Although such nodular lesions, exudative and interstitial inflammations are characteristic of a multiplicity of pulmonary conditions, when a positive history is obtained with the previously described characteristic findings, an early roentgen diagnosis of primary pulmonary coccidioidomycosis is made plausible.

Bilateral Nodular (Local) Dissemination. Twelve patients in this series had in common this rather severe and extensive form of pulmonary involvement. It is notable that, of these 12 cases, 8 were Negroes. All 8 came from the same locality in the Southern California Desert and had been on duty approximately the same length of time, a period of about five months.

Characteristically in all of these cases, the roentgen examination showed a widespread distribution of nodular type lesions throughout the parenchyma of both lungs. This distribution appeared to be of a local disseminated type. The individual nodules were of similar size in some cases, and varied in size from about 5 mm. to 2.5 cm. in others. They were frequently sharply circumscribed in outline, closely resembling metastatic carcinoma, or were possessed of indefinite and feathery edges, then simulating bronchopneumonia. In this latter form, the margins of these lesions appeared to merge with the surrounding pulmonary parenchyma, which in turn showed areas of mottling and haziness due to bronchovascular infiltration. This form, because of the greater tendency to pneumonic consolidation, indicated a more severe prognosis. The nodules were usually seen disposed in relation to the tracheobronchial tree, being more numerous near the hilum and at the lower third of the pulmonary field, where they appeared to radiate off the main branches like clusters of grapes. Very frequently hilar lymphadenopathy, peribronchial infiltrations and parenchymal consolidations were associated, and these appearances also contributed to the impression of a more severe prognosis for these cases. These typical nodular, bilateral infiltrations were seen in 20 per cent of the total number of cases.

This roentgen form may begin to show resolution within several weeks. However, when the infiltrations change slightly on serial studies, the progress from this condition to the granulomatous stage may follow either suddenly and violently, manifesting a short course or may take place slowly and perniciously over a long period of time.

In none of these 12 cases were any extrapulmonary manifestations noted, such as cutaneous, osseous or meningeal lesions. The absence of these manifestations, the relatively short duration of the disease, the presence of these nodules throughout the pulmonary fields apparently by a process of local extension rather than by hematogenous spread, all appeared to indicate that these patients were being observed in the primary stage of coccidioidomycosis rather than in the chronic or generally disseminated stage. It is notable that the distribution and persistence of these lesions are not only of roentgen diagnostic value in that these appearances may be consistent with this early and severe stage of the disease, but they are furthermore of considerable importance in that they modify the prognosis accordingly.

Fundamentally, however, as has been indicated in the consideration of the milder roentgen groups, the prognosis must be based on the established balance between the quality of the seed and the character of the soil. The roentgenological appearances, the erythema nodosum and the positive skin test all reflect the state of the patient's immunity and resistance. It is occasionally seen that a mild pulmonary lesion progresses to a fulminating generalized coccidioidal dissemination within a few weeks in a sufficiently susceptible individual. On the other hand, this severe, bilateral, disseminated type may clear fairly rapidly in another individual who may have sufficient immunity to localize or wall off the infection.

The following case histories illustrate these conclusions and demonstrate the roentgenological character and course of this severe form of primary coccidioidomycosis. The first case in this group is an example of the bilateral, nodular, locally disseminated process, which has become well walled off and which shows adequate resolution of these multiple lesions in a period of about five weeks.

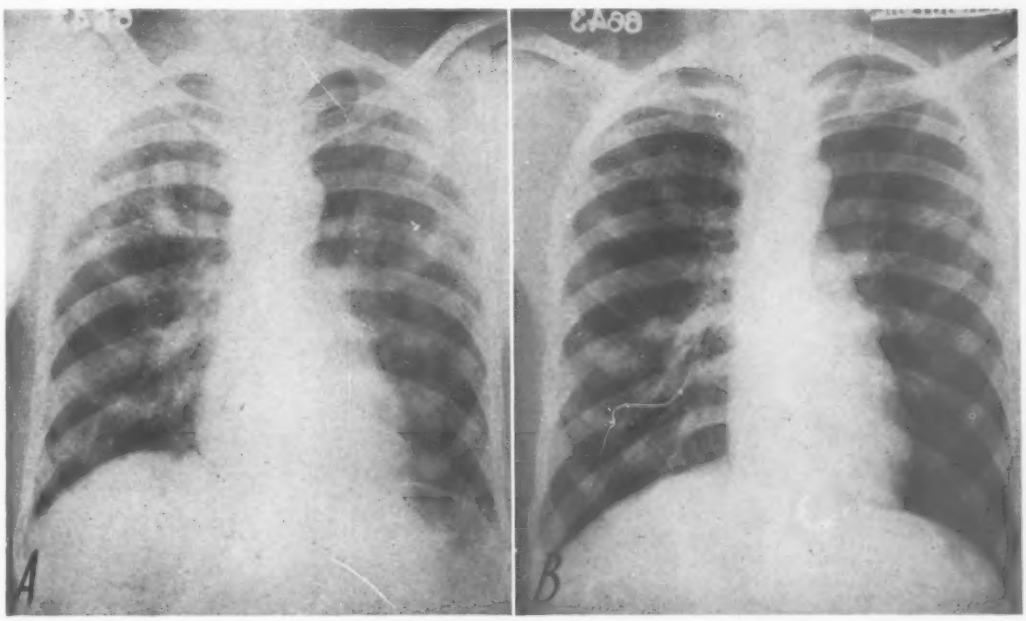

Fig. 7. *Bilateral (locally) disseminated type of primary coccidioidomycosis.* Case 1. (*A*) December 20, 1943. Bilateral and multiple infiltrations throughout both pulmonary fields. The nodules are sharply circumscribed and appear to be well walled off. (*B*) January 24, 1944. Five weeks later. There is now partial resolution of the previously noted lesions. The nodules are of much smaller size and linear shape.

Case 1. Negro, male, aged twenty-six; stationed in the Southern California Desert from June to December, 1942. Admitted on December 27 with cough, chest pain, malaise and mild fever. Eosinophiles 4 per cent, sedimentation rate 20 mm. per hour. Coccidioidin skin test (1:100) was positive. Complement fixation test on January 4, 1944, was positive; dilutions 1:2, 1:4, 1:8 were all 4+. Precipitin test was positive; dilutions 1:2, 1:10, 1:40 were all 4+.

Roentgen Findings. Examination on December 20, 1943 (Fig. 7A) showed both pulmonary fields to be occupied by multiple, nodular, sharply, circumscribed densities from apices to bases. On January 24, 1944, about five weeks later (Fig. 7*B*), partial resolution of these nodular areas had taken place; the lesions were now of smaller size and of linear shape. The hospital to which patient was later referred reported: "At present time, February, 1944, x-ray shows faint opacities well on way to resolution. Duty in ten days."

The following 2 cases represent the severest, most potentially fulminating, form of the primary stage of this disease. The nodular lesions here are of a soft and diffuse nature, and remain relatively unchanged on repeated examinations. The prognosis is consequently grave. Both of these patients are candidates for the chronic granulomatous stage, if they have not already progressed to this secondary state. No skin or bone lesions were observed in this group. In Case III the negative skin test corresponds with a negative tuberculin test in an overwhelming tuberculous infection. Roentgenologically, a parallel situation was observed in that the pulmonary lesions showed practically no change on serial

roentgenograms over a period of about seven weeks. Furthermore, advanced right hilar adenopathy and confluent consolidation at the right base contributed to the severity of the disease.

Case II. Negro, male, aged twenty-one; in Southern California Desert from July until December, 1943. Admitted December 14, 1943, with cough, chest pain, anorexia and high fever. Skin test for *Coccidioides* (1:100) was positive. Sedimentation rate 32 mm. White blood count 18,000; eosinophiles 13 per cent. Complement fixation test on December 30, 1943, was 4+ in dilutions of 1:2 and 1:4. The precipitin test was positive.

Roentgen Findings. Examination on December 14, 1943, showed both pulmonary fields to be involved by multiple, nodular lesions with fuzzy and hazy irregular edges. The intervening parenchyma showed associated infiltrative changes (Fig. 8*A*).

Case III. Negro, male, aged twenty-six; in Southern California from June to December, 1943. Admitted December, 1943, with cough, chest pain, moderate fever. Precipitin test was positive. The skin test for coccidioidomycosis was negative.

Roentgen Findings. Roentgen examination on January 27, 1944, showed both pulmonary fields to be involved by small nodular densities, with irregular hazy borders, varying from 5 mm. to 1.5 cm. in diameter. There was confluence of these nodules into a consolidated area in the right lower pulmonary field. An associated advanced right hilar adenopathy was present (Fig. 8*B*). The hospital to which the patient was later referred reported as follows:

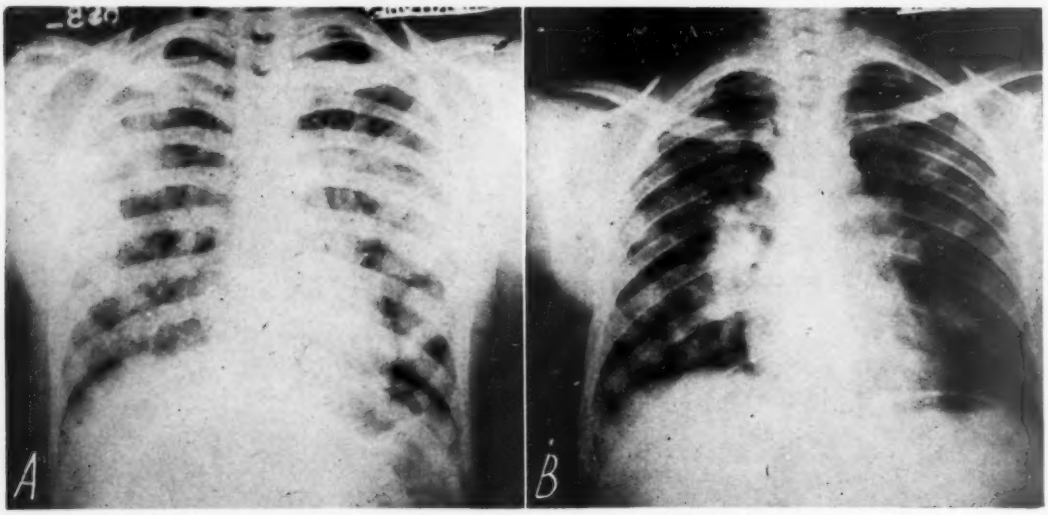

Fig. 8. *Bilateral (locally) disseminated type of primary coccidioidomycosis; most fulminating form; prognosis poor.*

(*A*) *Case* II. Both pulmonary fields are seen to be involved by multiple nodular lesions. The hazy and fuzzy edges indicate absence of a walling off process. There is marked surrounding inflammatory reaction.

(*B*) *Case* III. Both pulmonary fields are involved by small, irregular nodular densities. There is confluence of these nodules into an area of consolidation at the right base. Note the severe right hilar lymphadenopathy.

"The x-ray film on March 11, 1944, showed many bilateral opacities which were large and fluffy in appearance."

The next case demonstrates how a member of this latter group with a roentgenological picture similar to that seen in Cases II and III may go on to rapidly fulminating and fatal miliary dissemination. The negative skin test probably indicated overwhelming infection.

Case IV*. Negro, male, aged twenty-seven, was inducted into the United States Army in

* Courtesy Captain Donald Kent.

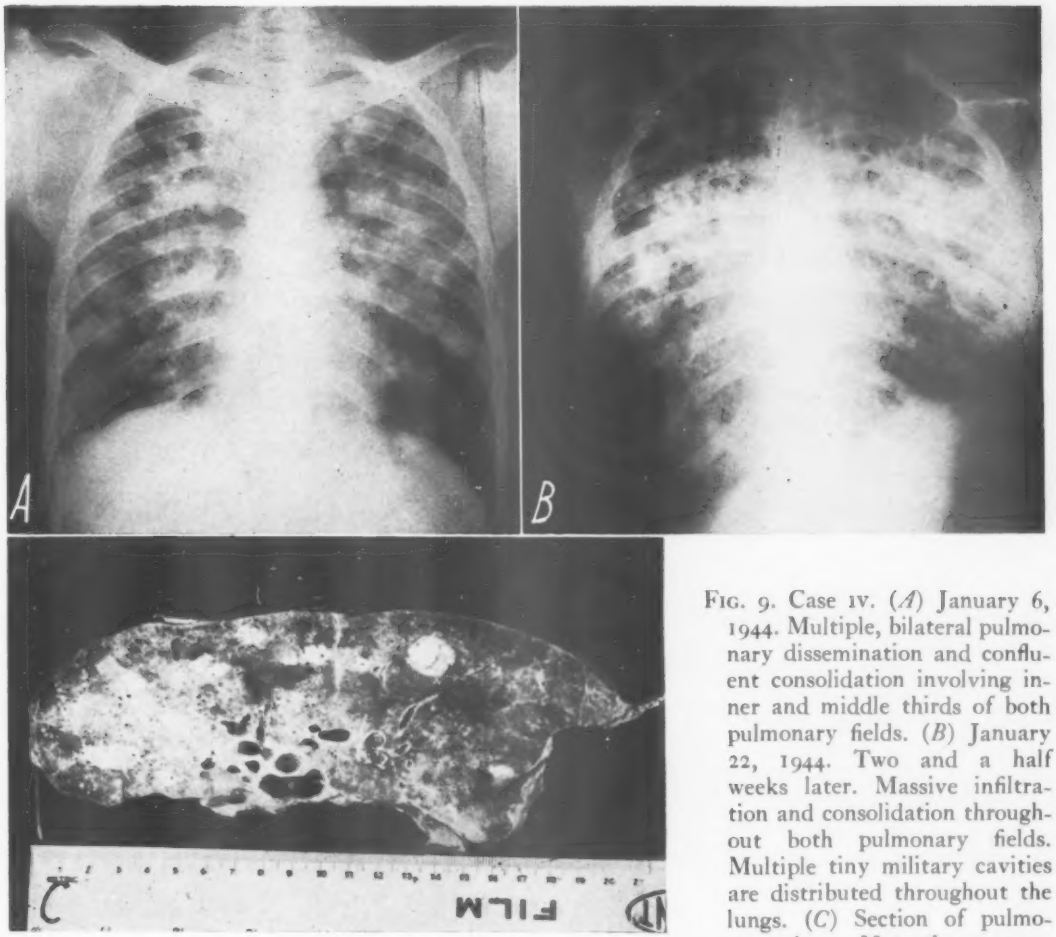

Fig. 9. Case IV. (*A*) January 6, 1944. Multiple, bilateral pulmonary dissemination and confluent consolidation involving inner and middle thirds of both pulmonary fields. (*B*) January 22, 1944. Two and a half weeks later. Massive infiltration and consolidation throughout both pulmonary fields. Multiple tiny military cavities are distributed throughout the lungs. (*C*) Section of pulmonary tissue. Note the presence of the pale gray nodules and the multiple small cavities. Smears of material from the pulmonary cavities showed spores of *Coccidioides immitis*.

July, 1942. Patient was a native of North Carolina. Previous occupation was that of a saw-mill worker. Previous family and personal histories were essentially negative. The patient had never previously been in California, New Mexico or Arizona. He first arrived in the Southern California Desert in July, 1943.

In the latter part of December, 1943, patient developed a cold with a grippe-like onset; he had a mild cough, substernal pain and fever. He was admitted to an evacuation hospital where a chest roentgenogram taken on December 27, 1943, showed "dense and fuzzy mottled infiltrations throughout both lungs." The clinical examination showed moist râles and increased breath sounds at both pulmonary bases. Temperature on admission 100.8° F., pulse 100, respiration 22. The examination was otherwise essentially negative.

Admitted to this hospital on January 5, 1944, because of continued fever. The coccidioidin skin test (1:100) was negative and remained so throughout the course. The complement fixation test was strongly positive in all dilutions. The precipitin test was strongly positive. Leukocyte count 11,000, with 87 per cent polymorphonuclears and 1 per cent eosinophiles; sedimentation 36 mm. Sputum was negative for tubercle bacilli and for coccidioidal spores.

Roentgen Examination on January 6, 1944 (Fig. 9*A*) shows an involvement of both pulmonary fields by multiple and nodular irregular densities. This process was as prominent in the remainder of the lung fields as in the apices and demonstrated no change as compared to pre-

vious roentgenogram of December 7, 1943. These nodular lesions were associated with surrounding areas of parenchymal infiltrations, especially in the regions of the inner and middle third of the pulmonary fields.

Clinical Course. The patient, on January 9, 1944, began to show a spiking temperature, which reached 103° F. in the afternoons, together with corresponding elevation of the pulse and respiratory rate. On January 20, clinical evidence of bronchopneumonia was observed. On January 21, sulfadiazine was started. On January 22, pneumococci were found in the sputum. In spite of vigorous supportive treatment, the patient's course was rapidly retrogressive and he died on January 23, 1944. Roentgen examination (Fig. 9*B*) January 22, about twelve hours prior to death revealed that practically the entire parenchyma was involved by a massively disseminated infiltrative process, with patchy areas of consolidation and with the presence of numerous tiny cavities of generalized distribution.

Pathological Findings (First Lieutenant W. B. Chamberlin, Jr., M.C.). Lungs: The pleurae were everywhere slightly thickened and roughened by fibrous adhesions. Scattered regularly throughout all lobes were a moderate number of roughly rounded cavities having an average diameter of approximately 1 cm. and not exceeding 15 mm. in diameter. These had a thin firm wall and were filled with pus and caseous material. Definite communication of some of them with smaller bronchi was noted. The lung tissue throughout was more firm than normal and only small portions of crepitant lung tissue were observed. Besides the cavities, moderate numbers of pale gray nodules 1 to 2 mm. in diameter were scattered throughout the lungs (Fig. 9*C*).

The pulmonary arteries and veins were normally patent and thin walled. The trachea and bronchi were partially filled with pus and caseous material. The mucosa of the trachea and main bronchi was smooth and glistening and showed no areas of ulceration. There was fusiform dilatation of some of the smaller bronchi in the vicinity of the cavities. Some of the smaller bronchi had granular mucosae.

The bronchopulmonary and mediastinal lymph nodes were all moderately enlarged, attaining a maximum diameter of 3 cm. They sectioned with ease, revealing mottled black, gray and white cut surfaces. Numerous pale yellow nodules were seen in some of them. No primary tuberculous complex was identified.

Microscopic Findings. There was moderate hyperemia. The alveolar walls were thickened and the alveoli were filled with fibrin in which pus cells and mononuclear cells were seen. Organization of this exudate was evident in many places. A MacCallum stain showed no definite bacteria. Focally, there were small to large areas of necrosis surrounded by a border of granulation tissue in which Langhans' giant cells were seen. In the necrotic areas were many spores with double contoured capsules, morphologically identical with the spores of *Coccidioides immitis*. These spores were better seen in the bacterial stain. One section which included the wall of a large bronchus showed lymphocytic, plasma cell and pus cell infiltration of the mucosa and lamina propria.

A frozen section of mediastinal lymph node revealed spores of *Coccidioides immitis* as did smears of the material from the pulmonary cavities.

Associated Findings. Military coccidioidomycosis of spleen and mediastinal lymph nodes, liver and kidneys. Chronic obliterative peritonitis.

This last case illustrates an unusual combination of reinfection tuberculosis and coccidioidomycosis. The outstanding features in this case are the following: The presence of acid-fast bacilli and spores of *Coccidioides immitis* in the sputum; the negative coccidioides and tuberculin cutaneous tests and completely negative complement fixation and precipitin serological tests—all indicating a severe pulmonary invasion.

Case v. Mexican, male, aged thirty, native of San Fernando, Mexico. Entered military service in January, 1943. Previous personal and family history was essentially negative. Hospitalized at a previous installation for seventeen days in November, 1943, because of fever. No diagnosis established. Admitted to another hospital on March 9, 1944; complaining of pain in the abdomen for four months, chest pain, weight loss of 20 pounds, and night sweats. Diagnosis of pulmonary tuberculosis was made here.

Admitted to this hospital on March 25, 1944, complaining of cough and chest pain. Physical

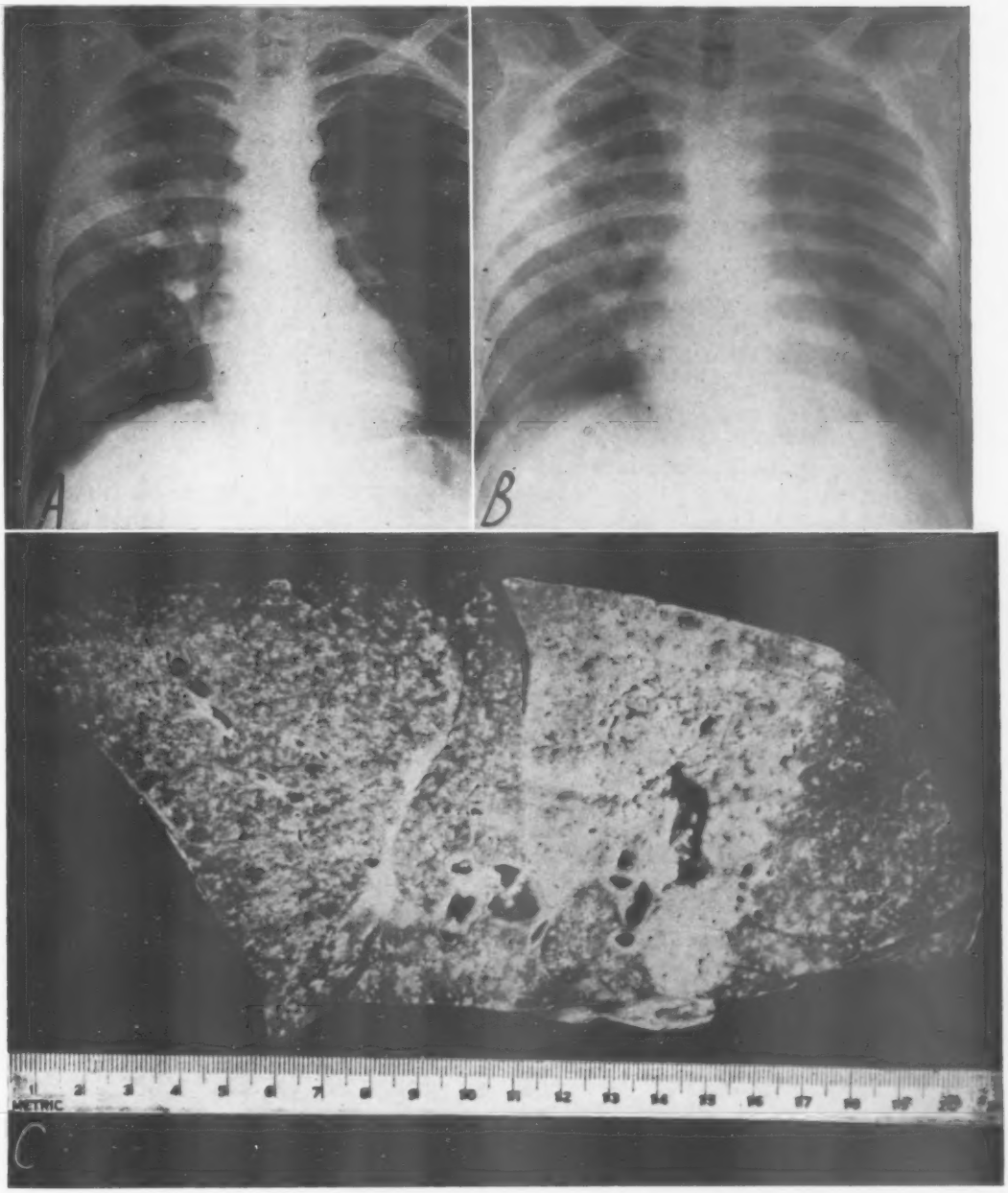

FIG. 10. Case V. (*A*) March 25, 1944. Roentgenogram shows an area of pneumonic consolidation involving the right upper lobe, in the central portion of which lies a cavity 2.5 cm. in diameter. Bronchopneumonic infiltration is present at the right base. (*B*) Five days later, there is an extensive spread throughout the pulmonary fields. (*C*) Section of pulmonary tissue. Note the consolidated lung tissue extending out from the right hilum. The central portion shows the previously described cavity. Small nodules are distributed throughout the remainder of the section.

examination: temperature, 103.8° F.; pulse 90; respiration, 24; blood pressure, 90/60. Physical signs of consolidation in right upper lobe; rest of physical examination negative.

Roentgen Findings. Examination on March 25, 1944 (Fig. 10*A*) showed an area of pneumonic consolidation in the right upper lobe with a cavity 2.5 cm. in diameter in the central

portion. There is associated bronchopneumonic type infiltration at the right base.

Follow-up roentgen examination on March 30 and April 1, 1944, showed rapid progress with extensive miliary type spread throughout both lungs (Fig. 10*B*).

Laboratory Findings. Erythrocytes, 4,300,000; hemoglobin, 85 per cent; leukocytes, 7,250, with 80 per cent polymorphonuclears, 18 per cent lymphocytes, and 2 per cent eosinophiles; Kahn reaction, negative; sedimentation rate, 34; hematocrit, 33; corrected rate, 13.

Skin Tests. Coccidioidin 1:100 negative; tuberculin 1:1000 negative.

Sputum showed acid fast bacilli and spores of *Coccidioides immitis.*

Complement fixation and precipitin reactions completely negative.

Hospital Course. Patient had a spiking temperature as high as 104.3° F., pulse up to 160 and respirations up to 80; chills and profuse sweating. He was given a 500 cc. blood transfusion on April 1, 1944. He was kept in an oxygen tent after March 29, 1944, but despite this he became progressively worse and died on April 3, 1944.

Pathological Findings (First Lieutenant W. B. Chamberlin, Jr. M.C.). Lungs (Fig. 10*C*): The pleura over the right upper lobe was roughened with fibrinous adhesions, but elsewhere the pleurae were thin. Pushing the pleura up everywhere in both lungs were numerous pale gray to pale yellow nodules having an average diameter of 2 mm. These were in places confluent. Crepitation was everywhere reduced and the cut surfaces were studded everywhere with nodules similar to those seen under the pleura. Extending laterally from the right hilum was a band of consolidated lung tissue having pale yellow cut surfaces. This zone of involvement embraced the lower portions of the right upper lobe and right middle lobe and had an average width of 5 to 6 cm. In the center of this zone was a roughly oval cavity 3 cm. in maximum diameter filled with pus. It had roughened soft friable walls. Throughout this consolidated zone were many places where caseous material could be scraped out. In the left lower lobe adjacent to the bronchus was a firm pale yellow round mass 1 cm. in diameter. The trachea, bronchi and pulmonary vessels were of average caliber with thin glistening linings. The bronchopulmonary and mediastinal lymph nodes were slightly enlarged but soft. They sectioned with ease revealing black cut surfaces mottled with pale gray.

Direct smears of the material from the cavity in the upper lobe of the right lung and from the nodules in the left lung revealed numerous spores of *Coccidioides immitis.*

Final Pathological Findings. (1) Acute ulcerative pulmonary coccidioidomycosis and tuberculosis, right upper lobe; (2) miliary coccidioidomycosis of the lungs; (3) acute fibrinous pleuritis, right. Associated findings were miliary coccidioidomycosis of spleen, lymph nodes, liver, and right kidney.

SUMMARY AND CONCLUSIONS

1. A series of 60 cases of primary coccidioidomycosis is presented, 6 proved by the isolation of the causative organism and 54 presumptive cases on the basis of clinical and laboratory findings.

2. The characteristic roentgenological manifestations, as observed in this series, are classified. A subgroup of 12 cases, representing an unusually widespread bilateral and severe locally disseminated form of the primary disease, is emphasized.

3. A relation between the inherent resistance of the host and the extent, severity and course of the pulmonary manifestations is indicated. Where the natural immunity is low, as is seen in the dark-skinned races, the disease may assume its most fulminating form and rapidly progress to generalized coccidioidal dissemination.

4. The pathological findings in 2 cases which came to autopsy are presented. Correlation of these with the roentgen appearances is demonstrated. The first case is an example of a generalized, fulminating, miliary coccidioidomycotic process which was superimposed upon the bilateral, multiple and severe form of primary pulmonary coccidioidomycosis. The second case is an unusual example of a combination of active tuberculosis and coccidioidomycosis.

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INTERLOBAR EMPYEMA*

By LIEUTENANT COLONEL JOSEPH LEVITIN
MEDICAL CORPS, ARMY OF THE UNITED STATES

WITH recent progress in the field of chemotherapy and the advent of penicillin in the treatment of infections, pulmonary complications are of less frequency and are not anticipated. As a result, the earlier work in the diagnosis of interlobar empyema (Clairmont,[1] Dieulafoy[2]) has almost been forgotten, and the diagnosis is established late or not at all. Roentgenology has so greatly facilitated the diagnosis of diseases of the chest that there has been a tendency to neglect, to a certain extent, the history and physical examination. This has been a disadvantage in the diagnosis of interlobar empyema, for the roentgen findings, though they may be highly suggestive, often do not give sufficient data to make such a diagnosis. The roentgen findings must be correlated with the history, the chain of events and the symptoms of the patient.

Interlobar empyema is a collection of pus in the interlobar fissure. These fissures lie between the lobes of the lung and connect freely with the pleural cavity. If adhesions unite the edge of the fissures we have a closed sac with retention of fluid, resulting in an encapsulated pleurisy. The sac itself may be divided by adhesions into multiple sacs and we may have only partial collections of fluid. This, of course, would make the roentgenological diagnosis more difficult.

The anatomy and the situation of the fissures has been well studied (Levitin[4]) (Fig. 1–11). The main fissure starts at about the level of the fourth rib posteriorly and courses obliquely forward. At the level of the hilum on the right side another fissure extends horizontally forward, dividing the right superior lobe into an upper and a middle portion. The appearance of the fissures, as seen on the roentgenogram, has been studied and described (Levitin and Brunn[5]). The situation of the fluid alters the true anatomic direction of the fissures in their true anatomic location. Previous chest pathology, such as adhesions or atelectasis, also alters the position of the fissure on the roentgenogram.

For a roentgen diagnosis of an interlobar effusion, anteroposterior and lateral views should be taken. Oblique views are in favor by the cardiologist to study enlargement of the auricles. It is also desired by the phthisiologist to demonstrate the presence of tracheobronchial glands. Oblique views are not satisfactory in the diagnosis of interlobar effusions. Except for the fissure between the right upper and middle lobes, oblique views cannot differentiate fluid in the interlobar fissures from partially consolidated lung (Fig. 1–11).

An interlobar aseptic effusion cannot be differentiated on the roentgenogram from an interlobar empyema. Pus does not cast a different shadow on the film from an aseptic effusion. Once the location of the shadow is established on the roentgenogram in the interlobar fissure, the history and physical findings must be carefully correlated to establish a diagnosis of empyema rather than an aseptic effusion.

DIAGNOSIS OF INTERLOBAR EMPYEMA

The symptoms of the onset of an interlobar empyema are the same as those of pneumonia and pleural effusion with pain on the affected side, fever and cough. There is a difference in the amount of dyspnea, which is not so marked with fluid lying in the free pleural cavity as when it is encapsulated between the lobes of the lung or between the lobes and diaphragm. After a few days of cough and fever the characteristic crepitant râles, tubular breathing and

* This article is based on material collected from the Department of Roentgenology, Mount Zion Hospital, San Francisco, before entering military service.

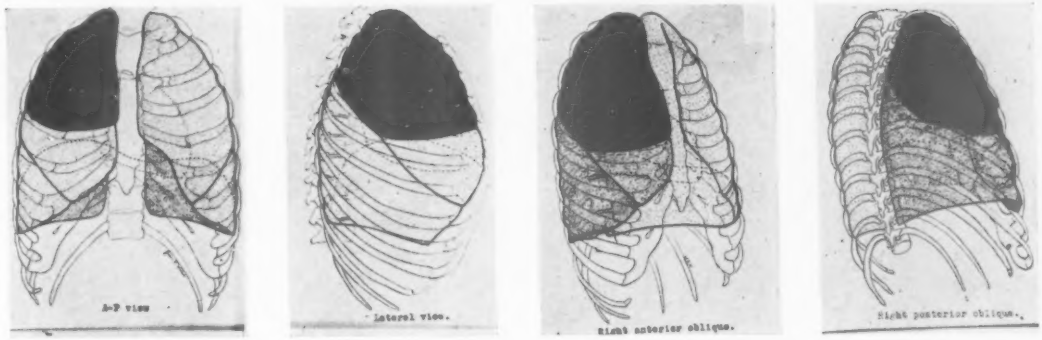

Fig. 1. The right upper lobe.*

* The anteroposterior and lateral diagrammatic views of the lobes of the lung and interlobar fissures in the figures are reproduced by permission from *Radiology*, 1935, *25*, 651–680.

rusty sputum of pneumonia are not found. There is a relative absence of physical signs as a healthy lung may surround the encapsulated pus. We may find a zone of dullness and tubular breathing from engorgement of the parts contiguous to the fissure, if it should lie close to the pleural surface. It is at this stage that a roentgen examination of the chest is so important, as it will demonstrate an area of density localized to the interlobar space. Hemoptysis has been noted, which may lead one to suspect a tuberculosis. This hemopytsis is due to ulceration of the walls of the interlobar space.

An important finding is the character of the sputum. Sputum is brought up late in the disease and is foul, containing considerable pus. It results from rupture of the encapsulated empyema into a bronchus. It is similar to the sputum in a lung abscess. The sputum can be predicted from one to several days in advance, before its evacuation, by the occurrence of a fetid breath. This is explained by escape of the fetid odors through small fissures developing between the interlobar space and the smaller bronchioles not large enough to allow the evacuation of the pus. The mode of expectoration of the pus is very characteristic of the disease. The patient is seized with a sudden fit of coughing and acute dyspnea followed by evacuation of purulent sputum which may be in large amounts. It is this purulent sputum which has given rise to the erroneous diagnosis of lung abscess. The history of fever, dyspnea, fetid breath and foul sputum, coupled with a roentgen diagnosis of interlobar effusion, establishes a diagnosis of an interlobar empyema.

TREATMENT

It is unusual for the encapsulated empyema to completely evacuate itself. Spon-

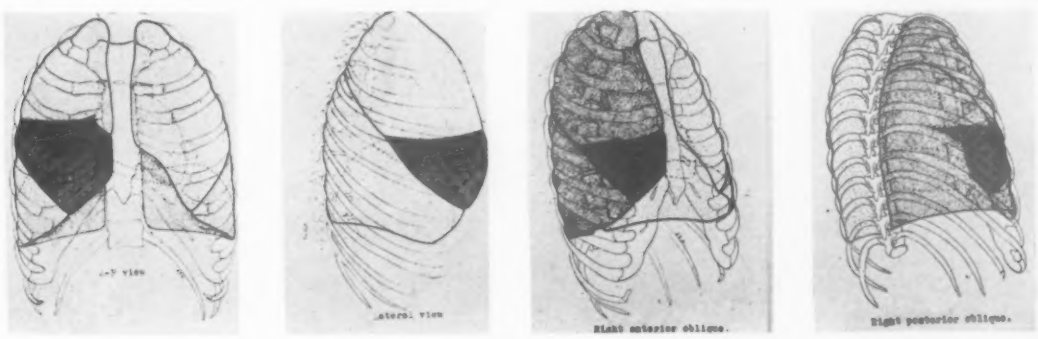

Fig. 2. The right middle lobe.

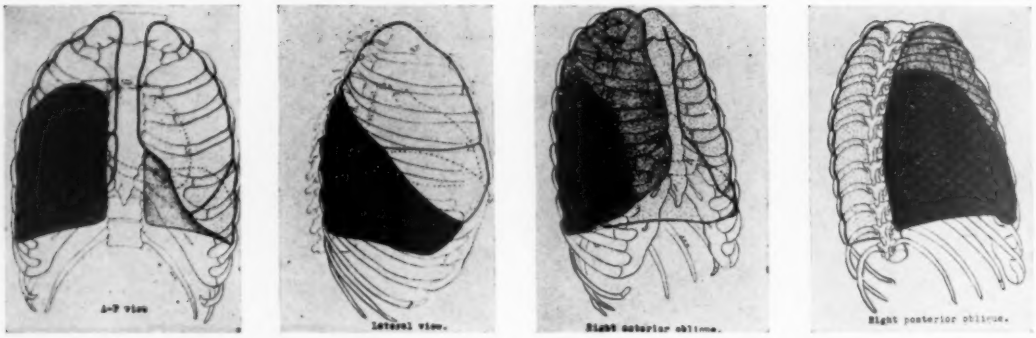

Fig. 3. The right lower lobe.

taneous evacuation should not be awaited as it implies the presence of bronchial fistulas and lung destruction. When the diagnosis is established surgery is indicated.

CAUSES

The causes of interlobar empyema are as follows:

1. Pneumonia.
2. Metastatic blood or lymphatic borne infection.
3. Direct trauma.
4. Lung abscess.
5. Primary infection.

1. *Pneumonia* is the etiologic factor in about 75 per cent of cases. Oftentimes the interlobar empyema is not recognized clinically and may be considered an unresolved pneumonia.

2. *Metastatic Blood or Lymphatic Borne Infection.* Septic thrombi may be carried by the blood stream from distant foci such as a purulent appendicitis, thrombophlebitis, and so forth, and lodge in that part of the lung neighboring a fissure and cause an interlobar empyema. Clairmont described 3 such cases, 1 following a furuncle of the neck, a second from a thrombosis of the left saphenous vein followed by infarcts in both lungs and a third case followed a resection of the stomach for carcinoma. Roentgenograms of the chest in all 3 cases showed an interlobar effusion, and at operation an interlobar empyema was found.

The lymphatics can also carry infection directly into the lung and interlobar fissure. The lymphatic communications between the hilar glands to the lymphatics of the fissures are well known. Not as commonly appreciated is the communication between lymphatics of the abdomen and chest. Empyema following acute appendicitis was so frequent in past years that it had its own term and was known as appendicular pleurisy (Dieulafoy). The literature in those days had frequent mention of interlobar empyema following abdominal surgery. Such transportation of infection is

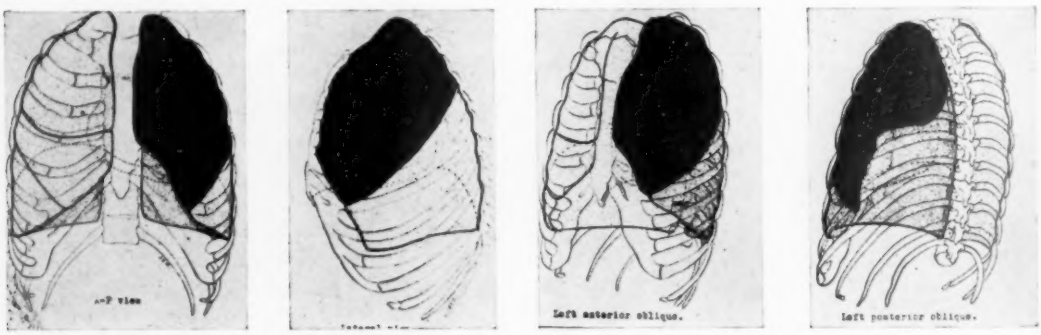

Fig. 4. The left upper lobe.

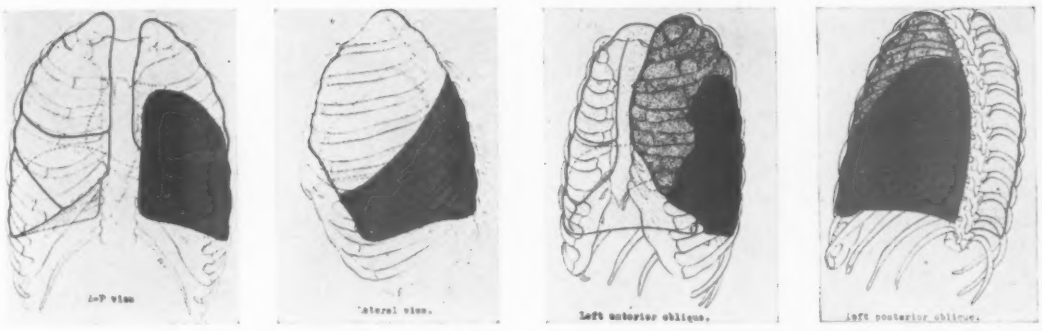

Fig. 5. The left lower lobe.

not so frequent today because the diagnosis of acute appendicitis is made earlier and the appendix is removed before complications develop.

Clairmont described 3 cases of lymphatic borne interlobar empyema following abdominal surgery. One followed eight days after an operation for a purulent appendiceal abscess with peritonitis. The second case had an operation for perforated duodenal ulcer, which was followed by a subphrenic abscess, gangrene of the right lower lobe and interlobar empyema. The third case was a resection for a duodenal ulcer. All 3 cases had the diagnosis of interlobar empyema confirmed at operation. He concluded from these 3 cases that an infection starting in the subhepatic space may jump over the subphrenic space and be carried by the lymphatics into the interlobar fissure. Another case occurring at Mount Zion Hospital also demonstrated the transportation of infection through the intact diaphragm. This patient had a ruptured appendix and peritonitis. On the thirtieth postoperative day he showed clinical and roentgen evidence of subdiaphragmatic abscess. Four days later he had effusion in the right pleural cavity and between the right upper and middle lobes. Foul pus was removed by thoracentesis. The same type of organism, *B. coli*, cultured from the peritonitis at time of operation, was found in the pus from the chest. In spite of operative and supportive treatment he died. Postmortem examination of the diaphragm showed it to be intact, no evidence of an ulceration, thick old adhesions on the peritoneal side in the region of the subphrenic abscess and adhesions, not so old, on the pleural side. Stained section of the muscle of the diaphragm showed *B. coli* within the fibers.

MacCallum[7] demonstrated the manner by which materials are transported through the diaphragm from the peritoneum into the pleural cavity by study of the anatomy of the tissues which separate the lumen of

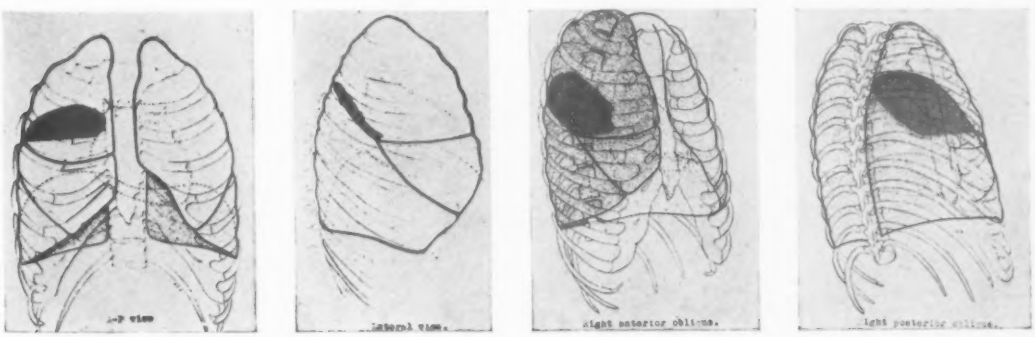

Fig. 6. The fissure between the right upper and right lower lobe.

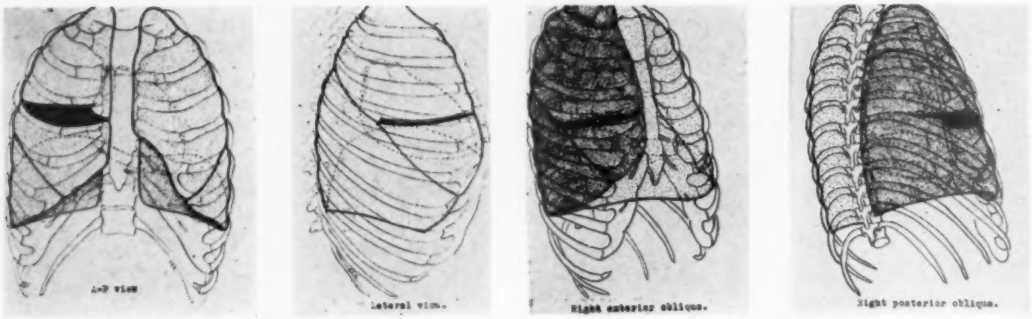

Fig. 7. The fissure between the right upper and right middle lobe.

the lymphatic channels from the cavity of the peritoneum. He found the lymphatics on the pleural surfaces of the diaphragm to anastomose abundantly, forming a network over the whole surface. On the peritoneal surface of the diaphragm the lymphatics lie in spaces between connective tissue fibers and are separated from the peritoneal cavity by a thin layer of tissue. These thin areas are the site for entrance of materials from the peritoneum. They are in the shape of sacs or lacunae which are absorbing terminals of the diaphragmatic lymphatics and are separated from the peritoneal cavity by loosely woven connective tissue and the peritoneal epithelium. Absorption of the granular material was brought about by phagocytosis. The peritoneum is not part of the lymphatic system and nowhere do the cells of each merge. It is possible to trace injected material from the sacs into the anastomosing trunks of the pleural network, then into efferent trunks and on into the mediastinal lymph glands.

The lymphatic borne pleural complication from infections in the abdomen occurs from about the seventh to the twentieth day after the onset of the infection. It is preceded by pain in the right hypochondrium radiating to the shoulder, as a result of infection either in the liver or subphrenic space. Pleurisy follows and there may be considerable effusion. The fever may be variable, but there is dyspnea, toxicity, loss of strength and a weak pulse. A pneumothorax may be present from the putrefactive organisms and does not necessarily indicate connection with a major bronchus. The course may be very rapid or there may be an encapsulation either in the pleural cavity or the interlobar fissure followed by expectoration of pus and symptoms as enumerated above.

3. *Interlobar Empyema from Chest Wound.* After a chest wound an interlobar effusion may develop which is in the nature of a serous or purulent exudate and is the result of direct trauma to the pleura or lung.

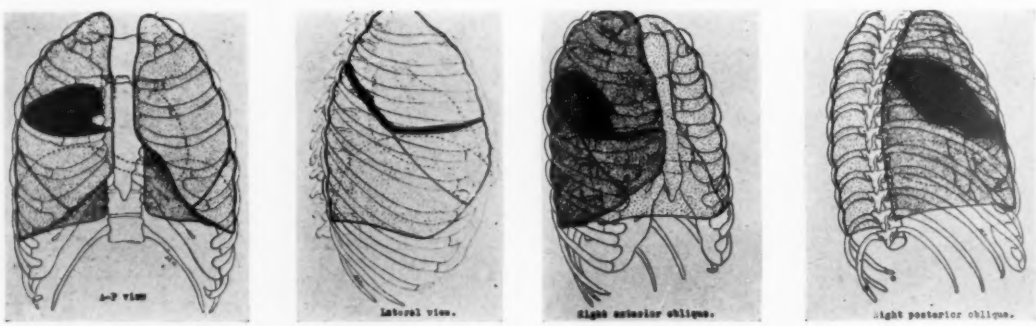

Fig. 8. The fissure surrounding the right upper lobe (upper and middle lobe anteriorly and upper and lower lobe posteriorly).

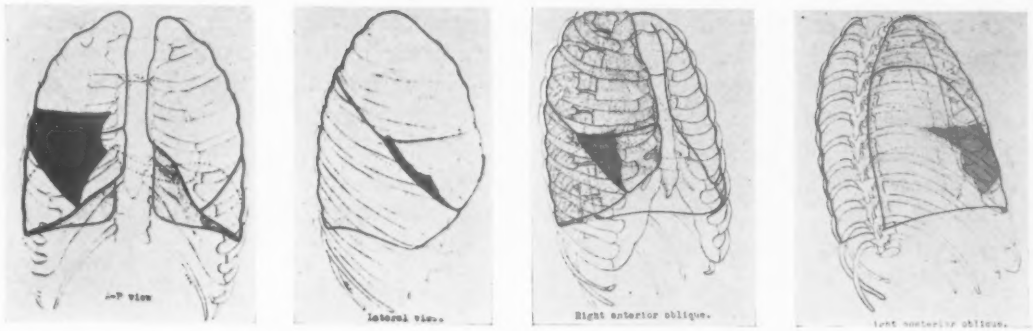

FIG. 9. The fissure between the right middle and lower lobes.

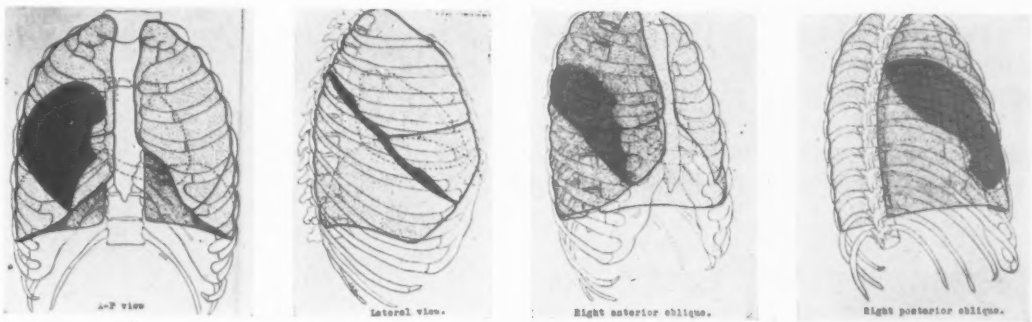

FIG. 10. The fissure bordering the upper surface of the right lower lobe.

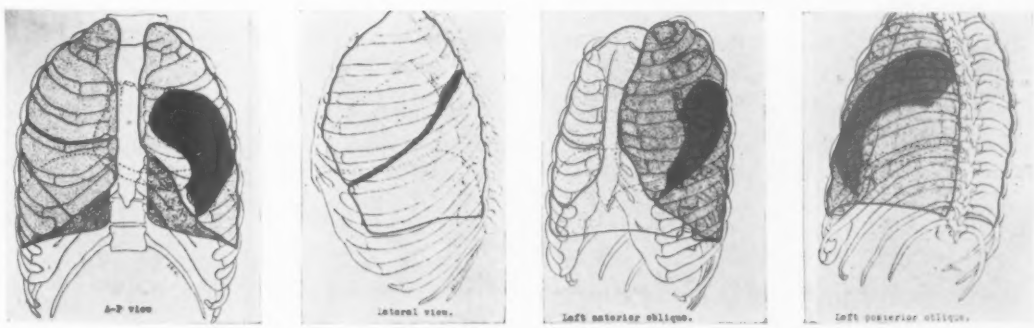

FIG. 11. The fissure between the left upper and left lower lobes.

Clairmont described a case of gun shot wound followed by subphrenic abscess and interlobar empyema. Straus[8] reported a case three weeks after an injury from a knife wound in the chest. An empyema was found and drained, with recovery.

4. *Interlobar Effusion Associated with Lung Abscess.* Lung abscess is far more frequent than interlobar empyema and an empyema in often incorrectly diagnosed when an abscess is present. The abscess cavity may rupture into the interlobar space and give rise to an interlobar empyema, or the reverse may be true—an interlobar empyema may rupture into the lung and give an adjacent lung abscess. Cases of interlobar empyema caused by a lung abscess have been reported by Weinberg,[10] Lilienthal,[6] Donzelot and Iselin,[3] Tixier and de Sèze.[9]

5. *Primary Infection.* Not all cases of interlobar empyema give a preceding history of pneumonia, distant infection or trauma. Dieulafoy suggested the possibility that an interlobar empyema may be a primary infection, just as we have a primary peritonitis, pleurisy or meningitis.

CONCLUSION

1. Interlobar empyema has a definite clinical syndrome. It is a complication which may follow
   a. Pneumonia.
   b. Metastatic infections carried by blood stream or lymphatics.
   c. Lung abscess.
   d. Trauma.
   e. Occur as a primary infection.

2. The characteristic history is pain on the affected side, fever, cough and dyspnea. The sputum is the most important finding which is foul, and simulates a lung abscess. The expectoration of sputum is preceded by fetid breath. The sputum occurs later in the disease and indicates rupture of the empyema into a bronchus.

3. Roentgen examination is the most important single aid in diagnosis. Proper examination in the anteroposterior and lateral views will localize the abnormal density into the interlobar fissure. Roentgen examination cannot differentiate the aseptic from septic fluid.

4. Treatment of an interlobar empyema is surgical.

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MULTIPLE FRACTURES IN THE LONG BONES OF INFANTS SUFFERING FROM CHRONIC SUBDURAL HEMATOMA*

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FRACTURES of the cranium are not infrequently associated with infantile subdural hematoma but fractures in the long bones have rarely been reported as complications of this intracranial lesion. An old fracture of the radius is mentioned by Sherwood[1] in his fifth case. Ingraham and Heyl[2] demonstrated greenstick fractures roentgenographically in the radiuses and ulnas of both forearms of one infant (Case 4) in whom there were neither clinical signs of fracture nor history of injury. Dr. Ingraham has written me that in his extensive experience with more than 100 cases of infantile subdural hematoma, fractures were also found in the humerus of one patient; in the femur of another; and in six ribs of a third.[3]

For many years we have been puzzled by the roentgen disclosure of fresh, healing and healed multiple fractures in the long bones of infants whose principal disease was chronic subdural hematoma. The subject of this paper is the description of 6 such patients who exhibited 23 fractures and 4 contusions of the long bones. In not a single case was there a history of injury to which the skeletal lesions could reasonably be attributed and in no case was there clinical or roentgen evidence of generalized or localized skeletal disease which would predispose to pathological fractures.

CASE REPORTS

CASE 1. H. D., male, was born March 13, 1925, after a normal gestation and labor; the birth weight was 8½ pounds. He gained and developed normally on a whole milk formula.

A purulent discharge from the right ear began at five months and continued for two months. At seven months there was a single convulsion which lasted for one-half hour, after which the infant was weak and listless for three days and strabismus with stare developed. During this period fever was present and vomiting was frequent. The mother, who had been with the infant continuously, had not observed injury to the head or extremities. Physical examination disclosed a tense bulging anterior fontanel, internal strabismus and exaggerated deep reflexes. There were no signs of meningeal irritation. The bones of the left forearms were thickened to palpation and this finding raised the question of an old fracture with callus. Roentgenograms of the extremities were not made at this time. Forty-five cubic centimeters of cerebrospinal fluid were withdrawn from the lumbar subarachnoid space; the pressure was increased but the fluid was normal chemically and microscopically. Following lumbar puncture the signs and symptoms disappeared; the patient was sent home after three days with the diagnosis of hydrocephalus of unknown origin.

Two weeks later the patient began to vomit and the bulge over the fontanel reappeared; 35 cc. of lumbar cerebrospinal fluid were found to be crystal clear and normal microscopically and chemically. During the next five weeks 30 to 40 cc. of normal cerebrospinal fluid were withdrawn during each of 12 lumbar punctures. At nine months of age subdural punctures yielded 25 cc. of bloody fluid from the right angle and 15 cc. from the left angle of the anterior fontanel. Roentgenograms of the skull after the injection of air into the subdural space demonstrated a large cavity which extended over both cerebral hemispheres but which did not appear to communicate with the subarachnoid or ventricular spaces. The patient was discharged December 24 to spend the Christmas holiday at home.

On December 28 the infant was re-admitted for further study and treatment. The four day sojourn at home had been uneventful and re-

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examination showed that the fontanel was depressed and widely open. A weakness of the right side of the face was noticeable when the patient was crying. The therapeutic lumbar punctures and subdural punctures were discontinued. On January 6, after nine days of continuous hospital residence, swelling of the right wrist was detected—slight dorsal swelling with ecchymosis and tenderness. No unusual trauma had been observed by any of the hospital attendants. Roentgenograms showed a fresh fracture of the right radius and old fractures of the left ulna and the right femur (Fig. 1). The fractured bones were well developed and well mineralized; there were no roentgen signs of scurvy. The fractured radius healed promptly and at three and one-half years the patient appeared to be normal showing no sequels of the subdural hematoma or the multiple fractures.

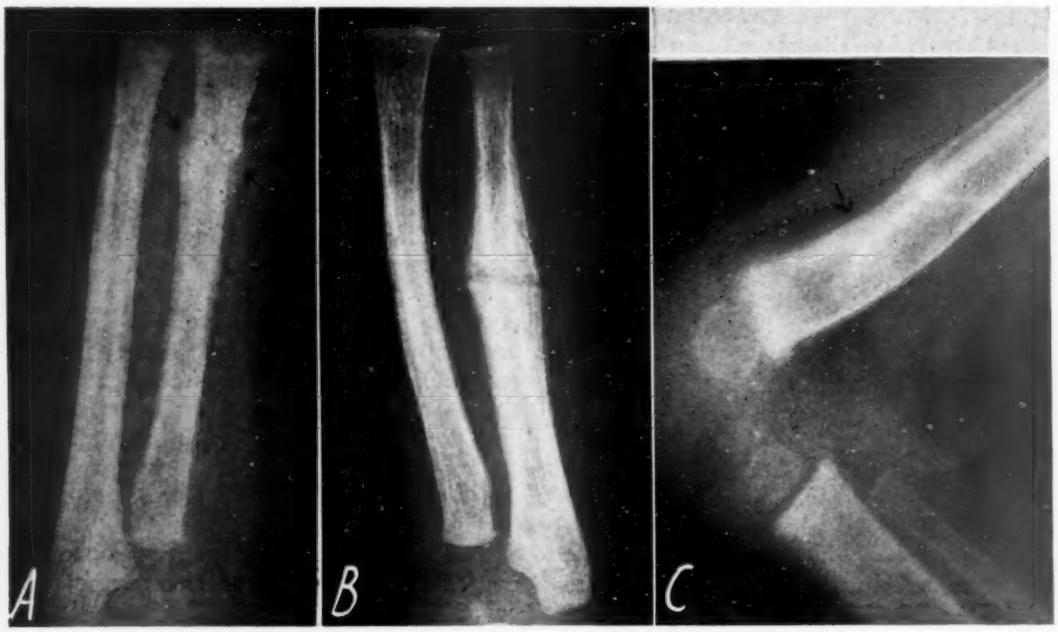

Fig. 1. Case 1. Roentgenogram at nine months, two months after the onset of subdural hematoma. (*A*) Fresh fracture of the right radius. (*B*) Old fracture of the left ulna. (*C*) Old fracture of the right femur with angular deformity. There are no roentgen signs of scurvy. The roentgen evidence suggests that the fractures are traumatic rather than pathological.

Case II. J. M., a white male born after normal gestation and labor on September 11, 1931, weighed 6½ pounds. Two blood transfusions were given during the neonatal period for the treatment of hemorrhagic disease of the newly born. He was breast fed for one month and then fed from a bottle until the eleventh month. Cod liver oil was given after the fifth month and 1½ ounces of orange juice were taken daily after the sixth month. Gain in weight was slow; at one year he weighed only 16 pounds.

During the seventh month the gums became swollen and hemorrhagic. In the tenth month blood was found in vomitus and feces. At the same time bluish and black spots appeared on the skin of the face and arms. The patient is said to have taken 1½ ounces of orange juice daily during the three months prior to the onset of these hemorrhagic manifestations.

A few weeks later during the tenth month the infant suddenly became cyanotic and rigid and remained so for one-half hour. Examination at this time in another hospital disclosed scattered petechiae in the oral mucous membrane and ecchymoses on the skin of the face, arms and trunk. The left side of the face and the left arm were weak. Numerous hemorrhages were found in the ocular fundi. The subdural space was aspirated through the left side of the anterior fontanel and yielded bloody fluid. At this time the clotting and bleeding times of the blood were normal and the blood platelets were nor-

mal in number. Hematuria was not demonstrated in several examinations of the urine. Roentgen examination of the extremities was said to have shown some osteoporosis but no changes diagnostic of scurvy and no fractures.

After discharge from the first hospital convulsions recurred frequently at home, often three and four times daily, until the fifteenth month when he was admitted to a second hospital. In examinations there the patient appeared to be undernourished and pale and there were numerous old ecchymoses on the head and thighs. The anterior fontanel was still widely open and mental development was retarded. The ocular fundi were normal. The bleeding and clotting times were not increased and there were 135,000 platelets per cu. mm. of blood. Fluid, withdrawn from the lumbar subarachnoid space, was yellow and contained 136 erythrocytes per cu. mm. In pneumograms of the skull the lateral ventricles were dilated and asymmetrical and the cranial sutures were widened. The blood Wassermann test gave a nonsyphilitic reaction. After a hospital residence of one month the patient was discharged improved.

After only four days at home and at sixteen months of age, the infant was returned to the hospital because of tenderness of the left leg which was said to have appeared suddenly without injury, four days previously on the same day that he had been discharged from the hospital. After re-admission the left leg was found to be hot, swollen and tender from the thigh to the ankle. There were purpuric patches on the skin over the left knee and ankle. Roentgen examination disclosed swelling of the soft parts of the left leg but no signs of scurvy or fracture in the bones (Fig. 2*A*). Two weeks later a shell of ectopic subperiosteal bone had formed around the lower three-quarters of the shaft of the left femur but there was still no evidence of fracture (Fig. 2*B*).

Fig. 2. Case II. (*A*) Lateral projection of the left leg at sixteen months of age, six months after the onset of subdural hematoma. The soft tissues of the thigh are swollen but there is no evidence of a fracture line or scorbutic changes in the bones. (*B*) Two weeks later than (*A*): a shell of cortical bone now surrounds the shaft of the femur with no evidence of a fracture line. (*C*) Lateral projection of the left femur at twenty-two months of age; a complete fracture of the femoral shaft is now present and the overriding fragments are imbedded in heavily mineralized callus. (*D*) Frontal projection of the left femur at twenty-seven months of age; healing of the fracture is more complete but there is still considerable deformity of the shaft.

At nineteen months of age he was re-admitted to the same hospital because of difficulty in moving arms and legs. The skull was trephined and the diagnosis of subdural hematoma was confirmed.

Convulsions recurred at twenty-two months and the left arm became partially paralyzed at the shoulder. Roentgen examination of the long bones showed a complete fracture in the lower third of the left femoral shaft with overriding of the fragments and a large mass of heavily mineralized callus (Fig. 2*C*). At the proximal ends of both humeri subperiosteal shells of bone surrounded the terminal segments of the shafts. There were no roentgenologic signs of

healed or fresh scurvy in the metaphyses.

At twenty-seven months the patient was admitted for the first time to the Babies Hospital. The head was enlarged and there was limitation of movement of the extremities, more pronounced on the right side. The ocular fundi were pale. Examination of the blood, urine and cerebrospinal fluid resulted in normal findings. Pneumograms of the brain disclosed marked dilatation of the ventricular system; there was no evidence of cranial fracture. In roentgenograms of the extremities the left femur was found to be thickened and deformed at the site of the earlier fracture (Fig. 2*D*). The distal end of the left humerus was fragmented and surrounded by externally thickened cortex and the shaft of the left ulna was cloaked in heavy cortical layers. The findings in the right humerus were similar to those at twenty-two months but there was a fresh fracture of the distal end of the right ulna with slight angulation.

Case III. J. B., a female Negro, was born March 10, 1933, after a normal pregnancy and labor. The birth weight was 5½ pounds. She was fed from the breast for two months after which a bottle was given with daily cod liver oil and orange juice. She developed normally.

At eight months she had a generalized convulsion and remained unconscious for several hours. After admission to another hospital two convulsions occurred during a residence there of six days. Convulsive seizures recurred at home, after four days the patient was brought to the Babies Hospital. She was found to be poorly nourished (6.7 kilograms) and short (70 cm.) with large head (43 cm. in circumference). The fontanel was not bulging and there were no signs of meningeal irritation. Multiple fresh hemorrhages were seen in each ocular fundus. Bloody fluid under increased pressure spurted from the needle inserted into the lumbar spine; this fluid was yellow after centrifugation. Subdural punctures on both sides of the anterior fontanel yielded blood-tinged fluid which remained yellow after centrifugation. Kahn's test on the blood and cerebrospinal fluid resulted in nonsyphilitic reactions. The urine was free of blood in several examinations. Subdural fluid was withdrawn at weekly intervals in the hospital and although the fluid remained blood tinged, the patient became brighter and more active. After one month the infant was discharged.

Four days later the mother brought the baby back to the hospital because the right leg had suddenly become tender and swollen and bruises had appeared under the left eye and in other parts of the body. The mother denied that any injury had occurred during the four days since discharge from the hospital. Movement in both lower extremities was found to be limited and the right leg was swollen and tender. There was a large ecchymosis on the left side of the face just beneath the orbit and numerous petechiae were scattered on the abdominal wall. Several fresh hemorrhagic foci were found in the ocular fundi. Lumbar subarachnoid fluid and subdural fluid, withdrawn from the lateral angles of the anterior fontanel, were discolored with blood. Roentgenograms of the extremities disclosed that the bones in the arms were normal but five fractures were visible in the shafts of the bones adjacent to the knee joints—one in the distal end of each femur, one in the proximal end of each tibia and one in the right fibula (Fig. 3). These bones were well mineralized and there were no signs of scurvy in the shafts, the metaphyses or in the epiphyseal ossification centers. In roentgenograms made eighteen days later heavy cortical thickenings surrounded the fractured shafts. The skull was not examined roentgenographically.

The patient remained in the hospital twenty-five days. The swelling and tenderness gradually subsided and disappeared. There were no later observations.

Case IV. R. M. S., female, was born December 3, 1942, after a normal gestation and labor; she weighed 6½ pounds.

Convulsions began at one month of age and recurred frequently thereafter. A "blood clot," presumably a subdural hematoma, was removed from the cranial cavity during the sixth month at another hospital. Following the operation the convulsions ceased and the vision seemed to improve.

At twelve months pain and tenderness were first noted in the left arm; these manifestations disappeared after two weeks and they did not recur. The mother stated that injury had not occurred at any time. Examination at another clinic disclosed that the movements of the left arm were limited and painful. The left arm was swollen above the elbow and extension of the elbow was limited to 165 degrees; flexion was normal. Pronation and supination were limited to 20 degrees.

Fig. 3. Case III. (*A*) Multiple fresh fractures at nine months of age; six weeks after the onset of subdural hematoma. There are transverse impacted fractures in the ends of the right femur, right tibia and right fibula. Small fracture fragments are visible on the medial aspects of the ends of the left femur and tibia. There are no signs of scurvy. (*B*) This roentgenogram, made eighteen days after (*A*), shows the cortical thickenings which have developed in the sites of the fractures.

The patient had resided in hospitals during most of the first year and presumably had received a normal diet with adequate vitamin C. Development was retarded. She failed to sit up or stand alone during the first fifteen months of life.

At fifteen months of age she was admitted to the Babies Hospital for the first time when she appeared well nourished. There was a long, healed surgical scar in the scalp; the left arm was flexed at the elbow and hung motionless except when touched. Both active and passive movements of the left arm were painful. Microscopic and chemical examinations of the blood and urine were normal. Kline's test on the blood gave a nonsyphilitic reaction. Clear cerebrospinal fluid withdrawn from the lumbar spine, was normal microscopically and chemically. The ocular fundi were pale.

In pneumograms of the skull the cerebral ventricular system was found to be dilated and there was considerable irregularity in the density of the parietal bones in the sites of earlier craniotomies which were done during the sixth month of life. Roentgenograms of the long bones disclosed cortical thickenings in both humeri. At the proximal end of the right humerus there was a deformity with displacement of a terminal diaphyseal fracture fragment and its attached epiphyseal centers (Fig. 4). In contrast, only the distal end of the left humerus was thickened. In the distal end of the right tibia there was an old transverse metaphyseal fracture with thickenings of the cortex and displacement of the distal fracture fragment and its attached epiphysis. There were no changes suggestive of old or recent scurvy or rickets.

Following discharge from the hospital the patient did not return for follow-up observations.

Case V. M. C., male, was born September 4, 1936, after a normal pregnancy and labor; the birth weight was 7 pounds. He thrived on breast milk until the fifth week when he suddenly became weak and dyspneic and remained so for three days when a single convulsion occurred. No injury was observed prior to the onset of these complaints. A few hours after the convulsion he was admitted to the Babies Hospital

and was found to be somnolent but hyperirritable when disturbed. Respirations were irregular. The anterior fontanel protruded but the neck was not stiff and there were no signs of meningeal irritation. Subdural fluid withdrawn from the left side of the anterior fontanel was blood tinged as was subarachnoid fluid obtained from the lumbar spine. The patient became more alert after these punctures although the fontanel remained full and the sutures became widened. He vomited irregularly.

At two and one-half months the cranial circumference measured 42 cm. Bloody subdural fluid was obtained in aspirations from both sides of the anterior fontanel. There were no hemorrhages in the ocular fundi. Roentgenograms of the cranium revealed widening of the great sutures, and thinning and osteoporosis of the calvarium but no fractures were visible. The extremities appeared to be normal clinically; roentgenograms of them were not made.

At five and one-half months the patient was re-admitted for two weeks with bilateral purulent otitis media. No abnormalities of the extremities were noted in the physical examination.

The patient re-entered the hospital at seven months of age. Six days before black and blue spots had appeared on the forehead and face.

Fig. 4

Fig. 5

Fig. 4. Case iv. Multiple healing fractures at fifteen months of age—fourteen months after the onset of subdural hematoma and three months after the appearance of pain and limitation of movement in the extremities. (*A*) Cortical thickening and deformity of the proximal end of the right humerus with displacement of the epiphysis and attached diaphyseal terminal fragment. (*B*) Lamellated thickening of the distal end of the left humerus. (*C*) Cortical thickening of the distal end of the right tibia.

Fig. 5. Case v. (*A*) Fresh spiral complete fracture of the femur at seven months of age, six months after the onset of subdural hematoma. (*B*) Healed fractures and angular deformities in the radius and ulna at seven months of age; there was also a fresh impacted fracture of the proximal end of the humerus. There are no roentgen signs of scurvy in the metaphyses and epiphyses. The fractures in the radius and ulna are old and possibly occurred during the same traumatic episode which caused the subdural hematoma in the first month of life.

Similar spots were observed on the hands, feet and back on the day of admission. Six hours before admission the left thigh began to swell and the infant cried out with pain when the thigh was touched or attempts were made to move him. The mother denied that the patient had been injured. Orange juice had been started at three months of age and had been taken in daily dosage of approximately 1 ounce.

Scattered ecchymoses were found in the skin of the face and extremities. The left thigh was diffusely swollen and tender; it was held in abduction and flexion. There were no hemorrhages in the ocular fundi. Subdural taps on the right and left side of the anterior fontanel yielded blood-tinged fluid. The blood and urine were normal microscopically and chemically; there was no hematuria. The bleeding time was two and one-half minutes; the clotting time was six minutes; there were 490,000 blood platelets per cu. mm. Kahn's test on the blood gave a nonsyphilitic reaction.

Roentgenograms of the extremities disclosed a fresh, long, spiral fracture of the left femur and an impacted fracture in the proximal metaphysis of the right humerus. Old healed fractures with angular deformities (Fig. 5) also were evident in the middle thirds of the right radius and ulna. There were no roentgen signs of old or recent scurvy. In the cranium there were no visible fractures.

The left lower extremity was fixed in traction for five weeks and the femoral fracture healed satisfactorily. The patient was discharged to an institution for chronic care and has not been observed since.

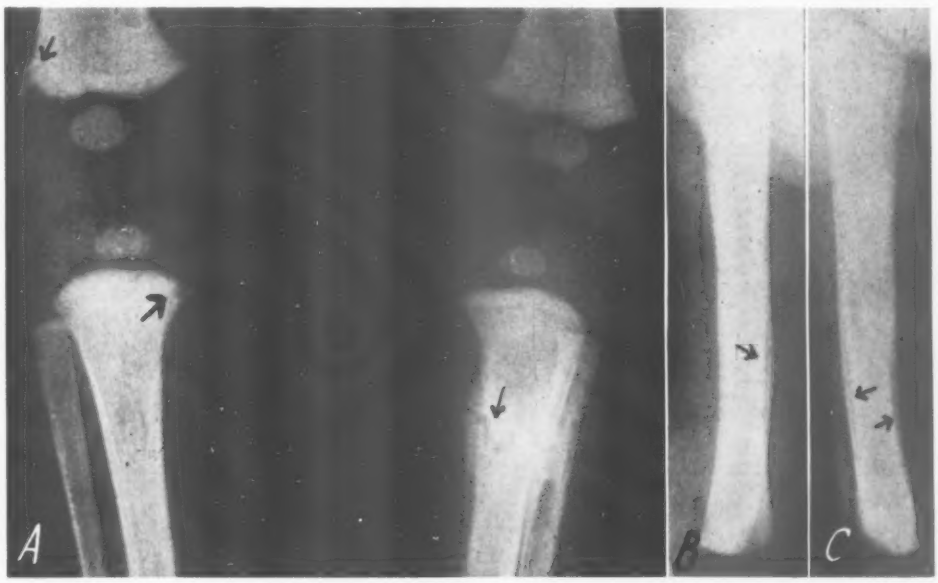

Fig. 6. Case VI. The long bones at six weeks of age. (*A*) Healing complete fracture of the left tibia and fine fragmentation of the distal end of the right femur and the proximal end of the right tibia. (*B*) and (*C*) Delicate subperiosteal thickenings of the humeri. It is probable that all of the skeletal injuries were caused by the same unrecognized causal agent which caused the subdural hematoma. Obstetrical injury is unlikely because the infant was born after cesarean section.

Case VI. A. L., female, was born on December 6, 1942, after cesarean section. She weighed 6 pounds. During the first two weeks she appeared to be normal and suffered no recognized injuries.

Convulsions and projectile vomiting began at the end of the second week. Thereafter convulsions recurred frequently, often as many as four times daily.

During the *sixth* week the mother noted that the infant's left leg was limp and tender. Injury to the baby was specifically denied; only the mother had cared for the infant. The head was large and measured 17 cm. in circumference. The anterior fontanel was large, full and tense. Both eyes showed proptosis and the vision appeared to be poor. Forty-five cubic centi-

meters of bloody subdural fluid was withdrawn from the right side of the anterior fontanel and 15 cc. from the left side. This fluid was yellow after centrifugation. Roentgenograms of the extremities showed a partially healed, complete transverse fracture of the left tibia and fine fragmentation of the distal end of the right femur and the proximal end of the right tibia (Fig. 6). Delicate layers of subperiosteal bone overlay the external surfaces of the humeri. There were no roentgen signs of scurvy and no hematuria. In roentgenograms of the skull the sutures were widened but there were no fractures. The bones of the thorax and pelvis were normal.

Subdural fluid was withdrawn in large amounts in repeated aspirations and at ten weeks a subdural hematoma was removed after craniotomy. The postoperative course was satisfactory. The patient returned to the care of her private physician.

COMMENT

The skeletal changes are summarized in Table 1 and their distribution is depicted schematically in Figure 7. In the aggregate all of the large bones in the upper and lower extremities were fractured but the small bones of the hands, feet, wrists and ankles were not affected. The epiphyseal ossification centers were all intact and fractures were not found in the cranium or in the flat bones of the pelvis and shoulder girdle.

Save for the fractures, the entire skele-

TABLE I

SUMMARY OF IMPORTANT DATA IN SIX CASES

Case Number	Bones Affected	Total Lesions	Fractures	Contusions	Location Fracture		Following Subdural Hematoma	History Trauma	Remarks
					Metaphyseal	Diaphyseal			
I	Radius Ulna Femur	3	3	0	0	3	1	0	Fracture of radius during hospital residence without recognized injury
II	Femur Humerus (2) Ulna (2)	5	4	1	2	2	5	0	Skeleton normal roentgenographically at onset of subdural hematoma
III	Femurs (2) Tibias (2) Fibulas	5	5	0	5	0	5	0	All fractures located in opposing bones at knee joint
IV	Humerus (2) Tibia (2)	4	3	1	3	0	4	0	Clinical signs of fracture appeared 11 months after first convulsion
V	Femur Tibia Radius Ulna	4	4	0	1	3	2	0	Fractures of radius and ulna probably neonatal; fractures of humerus and femur occurred at 7 months of age
VI	Humerus (2) Tibia (2) Femur	6	4	2	3	1	0	0	Cesarean section; first convulsion in second week of life
TOTAL	26	27	23	4	14	9	17	0	

tons of all patients appeared to be healthy; this was true of the fractured as well as the unfractured bones. There was neither clinical nor roentgen evidence to support the idea that pre-existing systemic or localized skeletal disease weakened the bones and made them unusually vulnerable to trauma.

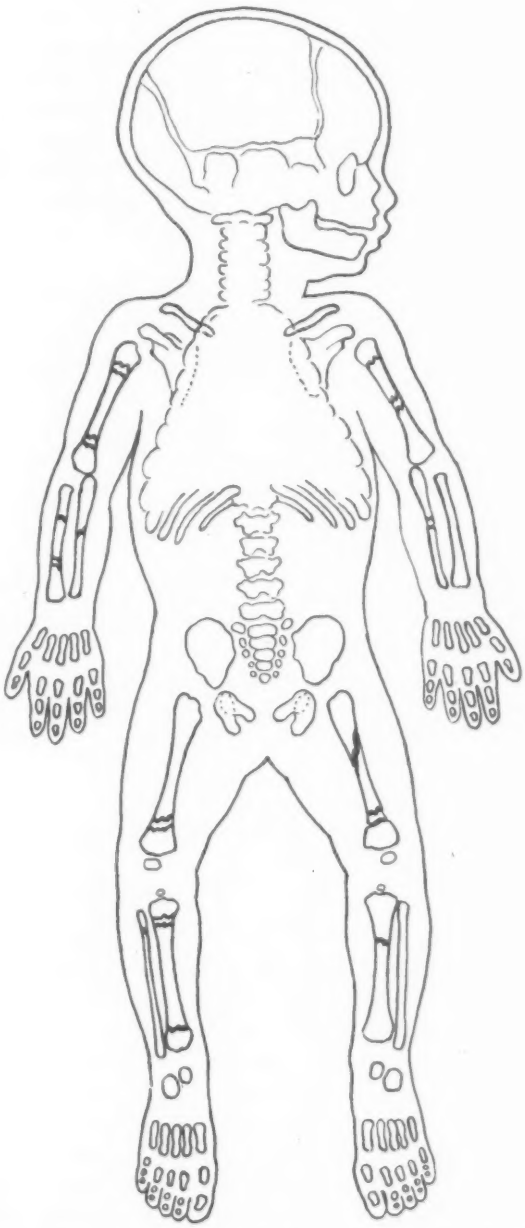

FIG. 7. Spot map of the skeleton showing the distribution of the 23 fractures in 6 patients.

The large cortical thickenings associated with several of the fractures (see Fig. 2*B* and 3*B*) are similar to the cortical thickenings which develop in many cases of scurvy following subperiosteal hemorrhage. The other roentgen signs which characterize active scurvy are, however, conspicuously absent in these cases—changes in the metaphyses, spongiosa, corticalis and epiphyseal ossification centers. Moreover 5 patients (except Case 1) appeared to have taken adequate vitamin C at the time fractures were found and none of them exhibited the clinical manifestations of active

FIG. 8. Traumatic cortical thickening of the radius and ulna following an injury to an infant four and one-half months of age who had neither subdural hematoma nor scurvy. Orange juice had been taken in daily dosages of 2 ounces since the first weeks of life. In the original history the mother stated that the infant's forearm had suddenly become swollen one month before without precedent injury. After the demonstration of the roentgen findings she admitted that a few hours before the onset of the swelling of the forearm, the baby had rolled off a table and she had grabbed him by the left forearm and jerked him into the air to prevent his fall to the floor.

scurvy. During the first years of life when the periosteum is normally loosely attached to the underlying corticalis and is normally richly supplied with blood vessels, large subperiosteal hemorrhages commonly develop at the sites of traumatic fractures in nonscorbutic infants (Fig. 8). Two other features make the scorbutic origin of the fractures highly improbable. Nine of the fractures were located deep in the shafts (see ulna, Case I; femur, Case II; femur, Case V; tibia Case VI); scorbutic fractures in contrast develop characteristically in the metaphyses near the cartilage-shaft junctions. Furthermore angular deformities of the fractured bones persisted after healing in several bones (see femur, Case I; femur, Case II; humerus, Case IV; radius and ulna, Case V). Scorbutic fractures in our experience heal without residual angular deformities. Although scurvy has been described in a few cases of infantile subdural hematoma,[4,5] there is no convincing clinical or roentgen evidence that the patients in this group suffered from vitamin C deficiency.

When cortical thickenings were demonstrated in the absence of visible fractures, the lesions have been classified as periosteal contusions (see left humerus, Case IV and both humeri, Case V). Trauma to the periosteal blood vessels may cause subperiosteal hemorrhage, elevation of the periosteum, and local cortical thickening in nonscorbutic infants (see Fig. 8). The causal mechanism is similar to that of traumatic ossifying periostitis of the newly born.[6] It is also possible that fractures were actually present in the sites of the cortical thickenings but were invisible roentgenographically. Such was undoubtedly the case in the femur of our second patient. In an early roentgenogram (Fig. 2*B*) a large subperiosteal swelling was visible but there was no evidence of a fracture line; six months later however (Fig. 2*C*), at the same site a healed complete fracture, overriding of the fragments and massive callus were all evident.

The traumatic theory of the causation of subdural hematoma has been accepted almost to the exclusion of all other causes[7] despite the fact that a history of injury is lacking in almost one-half of the cases.[8] The negative history of trauma in so many cases can probably be best explained by assuming that sometimes lay observers do not properly evaluate ordinary but causally significant accidents especially falls on the head, and that other important traumatic episodes pass unnoticed or are forgotten by the time delayed cranial symptoms appear. Putman and Cushing[9] have pointed out that weeks or months may elapse between the original cephalic injury and the onset of the clinical signs of subdural hematoma. Also recognized injuries may be denied by mothers and nurses because injury to an infant implies negligence on the part of its caretaker.

The absence of history of trauma to the fractured bones cannot be explained in the same way. The injuries which caused the fractures in the long bones of these patients were either not observed or were denied when observed. The motive for denial has not been established. The clinical signs of fractures in the long bones usually appear immediately after injury and the causal relationship between the traumatic force and damage to the bone is clear. It is unlikely that trivial unrecognizable trauma caused the complete fractures in the femurs in Cases I, II and V; in the humerus in Case IV; and in the radius in Case I. Moreover in several cases ecchymoses were found near the sites of the fractures. There was a striking similarity in the course of events in Case II and Case III. In each case unexplained fresh fractures appeared shortly after the patient had arrived home after discharge from the hospital. In one of these cases the infant was clearly unwanted by both parents and this raised the question of intentional ill-treatment of the infant; the evidence was inadequate to prove or disprove this point. In Case I a fresh complete fracture of the radius with ecchymoses in the neighboring soft tissues developed after a continuous residence of nine days in the

hospital and, notwithstanding, injury was not observed or at least not admitted by the hospital attendants.

It is possible that some of the fractures in the long bones were caused by the same traumatic forces which were presumably responsible for the subdural hematomas. However, this was not the case in the majority of the fractures because 17 fresh fractures appeared many weeks and months after the first clinical manifestations of subdural hematoma and after the withdrawal of bloody fluid from the subdural space. In one patient (Case IV) fractures in the long bones developed six months after the subdural tumor had been removed surgically.

We have also considered the possibility that the long bones were injured and fractured during convulsive seizures. There is little evidence to support such a postulate. In not a single case did fresh fractures appear immediately following the convulsive seizure and complete fractures occurred in patients who had only mild convulsions. It has been demonstrated that the vertebral bodies of children may be fractured during the convulsive seizures of tetanus[10] but in these circumstances there were no associated fractures in the extremities. To our knowledge, fractures of convulsive origin in the long bones have never been demonstrated in the common severe confulsive diseases of infancy and childhood such as lead poisoning, meningitis, cerebral neoplasm and hypocalcemic tetany.

SUMMARY

(1) Six infants with chronic subdural hematoma and associated multiple fractures in the long bones are described.

(2) History of injury to the long bones as well as to the head was lacking in all cases.

(3) There was no roentgen or clinical evidence of general or localized skeletal disease which would have predisposed the bones to pathological fractures.

(4) The majority of the fractures developed after the onset of the subdural hematomas.

CONCLUSIONS

Fractures of the long bones are a common complication of infantile subdural hematoma.

The fractures appear to be of traumatic origin but the traumatic episodes and the causal mechanism remain obscure.

The presence of unexplained fractures in the long bones warrants investigation for subdural hematoma.

Routine roentgen examination of the long bones in subdural hematoma is necessary for the identification of fractures because many of them are silent clinically.

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POLYOSTOTIC FIBROUS DYSPLASIA AND OSTEOPATHIA CONDENSANS DISSEMINATA*

CASE REPORT

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FIG. 1

OSTEOPATHIA condensans disseminata and polyostotic fibrous dysplasia are clinical entities rarely observed. The opportunity to describe the occurrence of both in the same patient leads to the following case report:

F. G., white male, aged fifteen, of Polish parentage, was first seen in the University of Pennsylvania Hospital in 1931. He was apparently normal until the age of two, when, after a fall, a swelling was first noticed in the occipital region. This swelling gradually increased in size, but there were no associated symptoms.

At seven years of age the patient had an

FIG. 2

FIG. 3

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FIG. 4

abscess of a left maxillary molar tooth. The infection localized and drained spontaneously. Following this there was noted a progressive deformity of the left side of the face which became more marked as the patient became older.

When eleven years old, the patient sustained a fracture of both bones of the right forearm, which healed without incident. At the age of fourteen the patient was seen in another hospital, where a biopsy specimen of the occipital mass was obtained. The histopathologic diagnosis was osteochondroma.

Shortly before admission the patient was seen in the Dental Clinic of the University of Pennsylvania, where two maxillary and two mandibular molar teeth were removed. Roentgenograms made at that time showed abnormalities of the bones of the jaws.

The patient's parents and six siblings were living and well, and no history of anything suggesting an osseous dystrophy was elicited.

The patient was small in stature. His intelligence was estimated as normal. The head was asymmetrical and large in proportion to the rest of the body. There were marked prominences in the occipital and left frontoparietal areas, and the bones of the left frontal, zygomatic and mandibular regions were prominent, giving the face an asymmetrical appearance. There was a prominence of the right trochanter as compared with the left, a slight genu valgus, and the patient walked with a slight limp. There was no pubic hair, and the left testicle was hypoplastic; otherwise the sexual characteristics were normal. There was no record of any abnormal pigmentation. The remainder of the physical examination was negative.

The blood count was normal and the urine clear and of normal specific gravity. The blood calcium (on separate determinations) was 10.4, 11.3 and 13.3 mg. per 100 cc.; the blood phosphates, 3.7 mg. per 100 cc.

Roentgenograms made at that time show the following:

Fig. 5

Head (Fig. 1 and 2): Multiple areas of fibrocystic disease with scattered areas of increased density, involving the base of the skull and the bones of the vault, especially in the occipital and frontoparietal areas. Similar changes were present in the left mandible and the bones of the left side of the face. The changes were not strictly unilateral although more marked on the left side.

Long Bones (Fig. 3 and 4): Fibrocystic areas in left humerus, right tibia and fibula and right femur with multiple areas of osteopathia condensans in the upper ends of both femora and tibiae, and in the small bones of the hands and wrists.

The spine, chest and ribs were negative.

Pelvis (Fig. 5): Multiple areas of fibrocystic disease and osteopathia condensans in both ilia, with osteopathia condensans in the pubes and ischiae. There was marked asymmetry of the pelvic inlet.

Because of the multiple cystic areas and the increased blood calcium, and in spite of the skull changes, which were interpreted as juvenile Paget's disease, exploration of the parathyroids was advised but refused.

The patient was discharged in status quo, and it was not possible to have him return for follow up, although he was known to have continued in good health.

He was next seen in 1942, at the age of twenty-six, at an induction center. He had continued to be in good health, and had had no fractures, although the deformity of the head and face had progressively increased. Follow up roentgenograms at this time were permitted, but no other studies could be arranged.

These roentgenograms showed a marked increase in the disease in the bones of the head and face, although the character of the changes was the same (Fig. 6 and 7). The fibrocystic areas in the pelvis (Fig. 8) were much larger and more widely disseminated, as were those in the upper end of the right femur where there was evidence of incomplete fracture. The areas of the osteopathia condensans were more numerous and of greater size and density.

New sections from the biopsy specimen of 1930 were obtained through the courtesy of Dr. John Howard of the Misericordia Hospital. These were described by Dr. Robert C. Horn, Surgical Pathologist, University of Pennsylvania Hospital, as showing "a loose fibrous matrix containing many spindle cells and irregular bony trabeculae. A few of the trabeculae

Fig. 6

resembled osteoid tissue, suggesting that the bone had been formed directly in the fibrous tissue." The appearance was thought to be compatible with that of fibrous dysplasia as described by Lichtenstein.

Osteopathia condensans disseminata is considered to be congenital in origin and often familial in occurrence. Its presence in the above patient may therefore be presumed to be congenital; no data are available as to its possible presence in other members of the family. Polyostotic fibrous dysplasia, on the other hand, is said (Lichtenstein) to have no familial incidence and to display no hereditary tendency. Lichtenstein, and others, however, feel that it is congenital in origin. In this patient, the presence of a fibrous dysplasia, already observable at the age of two years, suggests an even earlier origin. The probability of its congenital origin is strengthened by the presence of another abnormality of bone growth, admittedly congenital, osteopathia condensans disseminata. The latter condition has been described in association with another congenital lesion, coarctation of the aorta (Phalen and Ghormley). Polyostotic fibrous dysplasia has been reported by Stauffer *et al.* in association with congenital arteriovenous aneurysms. It is well recognized that congenital variations in development are often multiple.

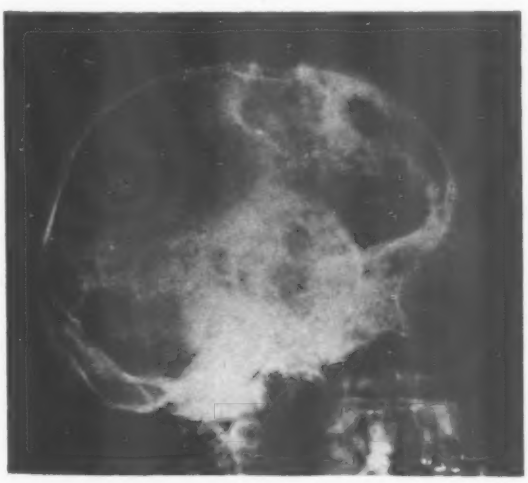

Fig. 7

Fig. 8

In general, the features presented by the above case are not unusual. During an eleven year period of observation the roentgen appearance of the lesions of osteopathia condensans disseminata had varied little from that ascribed to the condition by previous observers, and again, no symptoms attributable to the lesions were manifest. While the fibrocystic areas had increased in size, no new areas of involvement appeared, and except that no manifest fractures had occurred, the progress of this condition, too, was that of previously described cases, and no symptoms were produced. In spite of the fact that some areas were involved by both processes, no changes in the course of one were noted which seemed to be in any way related to the presence of the other.

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VOL. 56, NO. 2

TRAUMATIC PNEUMOCEPHALUS ASSOCIATED WITH CEREBROSPINAL OTORRHEA*

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PNEUMOCEPHALUS (intracranial pneumatocele or aerocele) associated with cerebrospinal rhinorrhea following fractures in the frontal region is not uncommon[3,5] and the surgical treatment of this condition when chronic is a well accepted procedure[1] (Fig. 1). However, the presence of intraventricular air resulting from middle cranial fossa fractures associated with cerebrospinal otorrhea is relatively uncommon. Worms, Didiée and Grumbach[7] collected 72 cases of intracranial pneumatocele from the literature and added a case of their own to the series. There were 3 cases in which the entrance of air into the intracranial cavity occurred as sequels of operations on the nose or mastoid sinus; 2 followed infections of the frontal or ethmoidal sinuses, and 1 occurred in association with an osteoma of the orbit.* The remaining cases were associated with skull fractures or bullet (or grenade) wounds of the skull. There were 10 cases in which the air entered the cranial chamber from the mastoid air sinuses or the ear; in 5 cases, otorrhea occurred, and the air was intraventricular. Operation for repair of the dural defect, such as practiced in cases of anterior fossa fractures with pneumocephalus and rhinorrhea was not done in any of the 10 patients, but 1 of them died. In the 1 mortality (Case 11[6]), necropsy revealed that there was a fistula between a large left temporal lobe abscess and the descending horn of the left lateral ventricle. It was Dandy's belief that the air was forced through the mastoid defect (produced by previous operation) into the abscess cavity by sneezing, coughing, or swallowing. Barden[2] recorded 2 cases in which air gained access to the intracranial subdural space following basal skull fractures.

The case which we are reporting is rather unusual in that necropsy excluded the possibility of direct entrance of air from mastoid cells or ear to the ventricular system and established the fact that the gas must have taken a circuitous route through the subarachnoid space to the ventricles by way of normal channels.

L.C., male, aged fifty-seven, fell down a flight of stairs on March 3, 1945, and was unconscious for an uncertain length of time. On admission to the hospital, he was quite alert and appeared normal. A discharge of clear serous fluid from the left external auditory canal was noted two days after the accident, and this ceased on the following day. Immediately after the appearance of the cerebrospinal otorrhea, the patient was given 2 grams of sulfadiazine and 2 grams of sodium bicarbonate by mouth every four hours for one day, and 1 gram of each drug every four hours thereafter. Roentgenograms of the skull showed gas in the ventricular system (Fig. 3) with evidence of a fracture line in the left temporal region extending into the base of the middle fossa. On March 11, 1945, he suddenly became confused, drowsy, and developed a paralysis of the entire left side of the face. A lumbar puncture was done, and 10 cc. of cloudy cerebrospinal fluid was

* Two of these relatively rare cases of intracranial pneumatocele occurring in association with orbito-ethmoidal osteomas have been described by Cushing.[4] The intracranial collection of air is the result of erosion of the ethmoidal or frontal sinus by the tumor. One of us (I.M.T.) with Dr. L. M. Davidoff operated upon such a case at the Jewish Hospital of Brooklyn (Fig. 2). The man, aged thirty-two developed a right frontal headache and left hemiparesis rather suddenly one week before hospitalization. This headache was intensified by sneezing which occurred frequently since he suffered from hay fever. At operation, the cortex and dura were found to be very tense. A needle was introduced into the frontal cortex, and at a depth of less than 2 cm. a large puff of air escaped from the needle, and the dura became quite relaxed. The rent in the dura over the perforated sinus (frontal or ethmoidal) was repaired by a graft taken from the fascia lata and sutured to the margins of the dura. Motor power in the upper extremity returned to normal the day after operation, recovery of lower limb function requiring several months.

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removed. The fluid contained 26,000 white blood cells per cubic millimeter, and the cells were mostly polymorphonuclear leukocytes. The patient was given 20,000 units of penicillin intrathecally and 10,000 units intramuscularly every three hours. In addition, 2.5 grams of sodium sulfadiazine were administered intravenously. In spite of continued treatment with penicillin and sodium sulfadiazine of approximately the same dosages as received initially, the patient died on March 15, 1945, twelve days after the accident. Blood sulfadiazine levels were 8.52 mg. per 100 cc. combined of which 7.31 was free drug on March 9; 6.4 mg. per 100 cc. combined and 5.62 mg. per 100 cc. free sulfadiazine on March 12, and 4.58 mg.

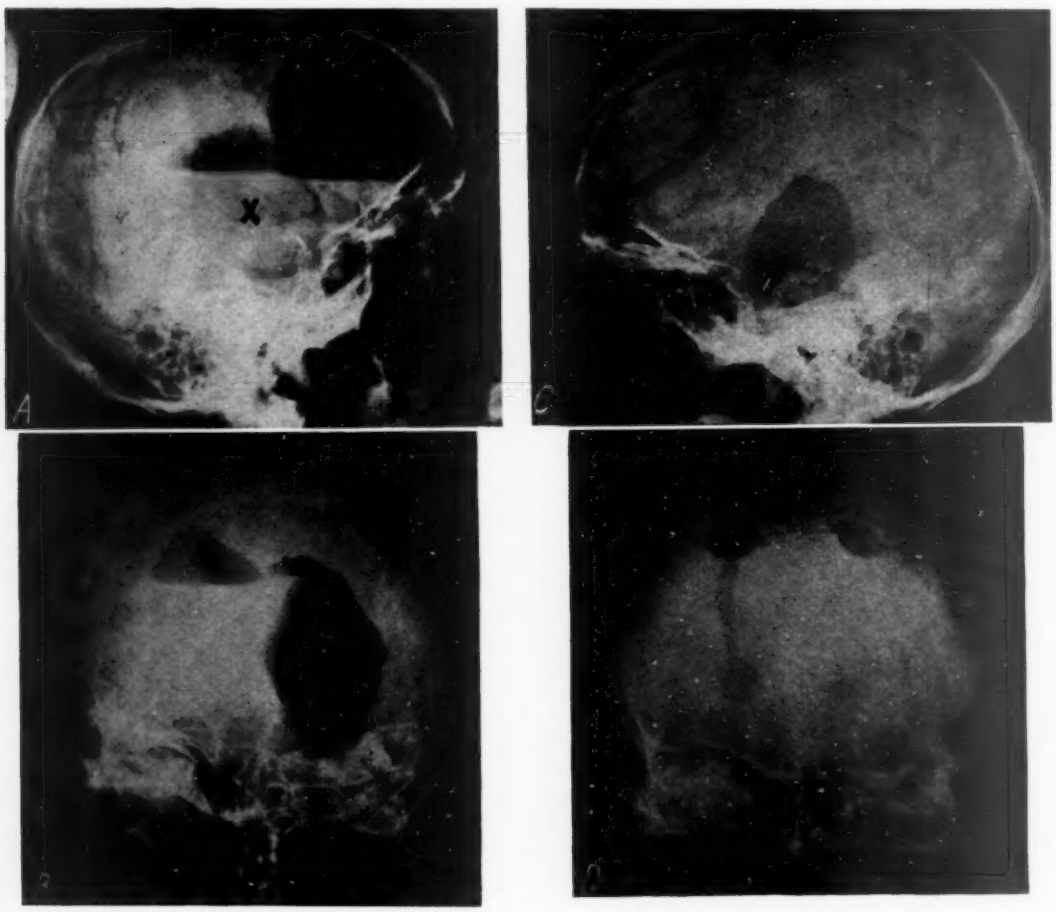

Fig. 1. Roentgenograms demonstrating air in the ventricle (v) and in a traumatic porencephalic defect (p). The extensive fracture line is seen crossing the frontal sinus. The bony defect (x) represents a right subtemporal decompression done six years previously because of "epilepsy." The cerebrospinal rhinorrhea occurred fourteen weeks after the patient sustained his injury following which he was unconscious for ten days. A fluid-air level is seen in the ventricles (*A* and *B*) and in the traumatic porencephaly (*A*).

At operation, a left frontal osteoplastic bone flap which extended to the right of the midline was elevated. A large traumatic porencephalic defect with yellow-stained walls was found in the left frontal lobe. This cavity was filled with fluid and air, and it communicated with the left ventricle and the left frontal sinus. The site of the fistula was readily identified by the attachment of the adjacent cerebral tissue of the inferior surface of the frontal pole to the 2 cm. defect in the dura mater and the frontal sinus. The meningocerebral scar was excised and a fascia lata graft interposed. The graft was sutured to the margins of the dural defect. Good recovery followed the operation, and there was complete cessation of the cerebrospinal fluid rhinorrhea. The disappearance of the air in the ventricles and in the porencephalic defect is seen in the postoperative roentgenograms (*C* and *D*).

per 100 cc. combined of which 4.06 mg. per 100 cc. was in the free form on March 14. Pneumococcus, Type III, was grown from the cerebrospinal fluid removed on March 11.

Autopsy was performed on March 17, 1945, by Dr. Henry Weinberg, Assistant Medical Examiner of New York, in the presence of Drs. and depressed, terminating in the left middle ear lateral to the opening of the facial nerve. On being opened, the middle ear (left) shows evidence of greenish fluid, the left ear drum being ruptured. No fractures of any other part of the calvarium including the frontal and ethmoidal sinuses is seen. Green pus covers both cerebral

FIG. 2. Roentgenograms showing: *A*, orbito-ethmoidal osteoma associated with intracerebral pneumatocele of the right frontal lobe; *B*, the osteoma is seen occuping the right and to a less extent, the left frontal and ethmoidal sinuses; *C*, postoperative roentgenogram shows absence of the intracranial portion of the osteoma shown in (*A*) and (*B*) with tumor still present within the sinuses. The pneumatocele was evacuated at operation.

Helpern and Vance. The report of the autopsy findings follows:

"There is a hemorrhage in the galea in the left parietal region and one in the left temporal region. The calvarium shows evidence of a comminuted linear fracture of the middle fossa commencing in the left parietal bone, 3 inches above the left external orbital process and extending downwards and backwards 1½ inches where it bifurcates and becomes comminuted hemispheres especially both frontal and parietal regions with contrecoup laceration of the tip of the right temporal lobe. There was no evidence of any laceration of the tip of the left temporal lobe. The brain on section showed dilatation of the lateral ventricles (slight in degree).

"The anatomical diagnoses were: suppurative leptomeningitis; traumatic fracture left middle fossa extending to the left of the midline; rup-

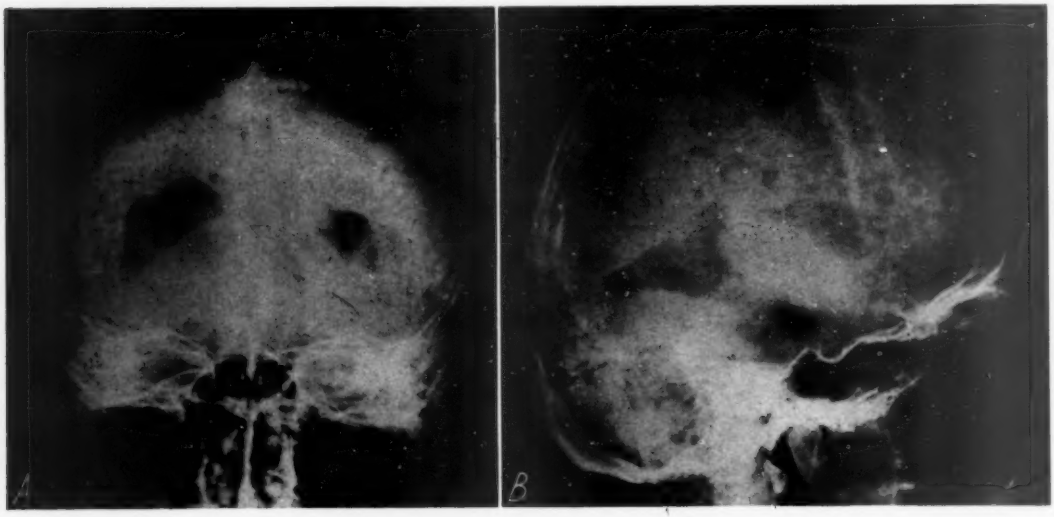

FIG. 3. Roentgenograms showing gas in the lateral ventricles. A linear fracture is seen in the left temporal region extending to the base of the middle fossa and crossing the petrous portion of the temporal bone (*B*).

tured left ear drum; contrecoup laceration of the tip of the right temporal lobe; generalized atherosclerosis."

In the case illustrated in Figure 1, and successfully treated by operation, air entered the porencephalic cavity from the frontal sinus and from there through the fistulous tract to the ventricle. However, such a direct pathway for the air in our case of cerebrospinal otorrhea is excluded by autopsy findings. The gas must have followed a more circuitous pathway. It might have entered the middle ear cavity by way of the eustachian tube or from the external auditory canal through the ruptured tympanic membrane; on the other hand, it might have come from the mastoid air cells directly. However, from either middle ear or mastoid sinus, the gas traversed the fracture in the petrous portion of the temporal bone. Although a tear in the arachnoid and dura were not seen at autopsy, they doubtless were present when the otorrhea appeared and probably healed subsequently. The air must then have entered the subarachnoid space, the basilar cisterns, and finally the ventricular system through the foramina of Luschka and Magendie. There was no contusion of the temporal lobe on the side of the fracture, no opening of the floor of the third ventricle, and no other direct pathway from fracture site to ventricular system.

We were quite surprised to find that air was present in the intracranial cavity in this case since the patient had no headache or other complaint during the first week of hospitalization, and he was very anxious at this time to return home. In fact, the cerebrospinal otorrhea was slight and may easily have been overlooked. If the roentgenogram of the skull had been taken on the day of admission and pneumocephalus disclosed, immediate sulfadiazine therapy would have been instituted, rather than two days later when the otorrhea appeared. It seems doubtful that the earlier therapy of sulfadiazine alone would have altered the course of events since the signs of meningitis did not appear until six days after the drug was started. Nevertheless, roentgenographic examination of the skull should be carried out as early as is feasible in cases of head injury and prophylactic therapy for infection started promptly if pneumocephalus is found or if fracture lines communicate with any of the cranial sinuses. The presence of pneumocephalus following an injury even in the absence of cerebrospinal rhinorrhea or otorrhea would in-

dicate that a pathway has been established between the cranial sinuses and the intracranial cavity. However, pneumocephalus may result from "infections of gas producing organisms—bacillus aerogenes capsulatus (of Welch) and possibly colon bacillus."[5] In any case, preventive treatment of intracranial infection would be immediately indicated. The appearance of rhinorrhea and pneumocephalus may be delayed for a considerable period of time after injury such as occurred in the case illustrated in Figure 1 in which the interval before appearance of rhinorrhea was fourteen weeks. During this time, disintegration of damaged cerebral tissue with formation of a porencephalic cavity must have occurred. Intervals of days or weeks after injury before symptoms (most commonly headache or other symptoms of increased intracranial pressure) of pneumocephalus developed was recorded in a number of cases collected from the literature.[5,7] In cases of intracerebral pneumatocele, progressive destruction may occur as a result of the irritating effect and the pressure of the air. This point is illustrated in the case shown in Figure 2 in which hemiparesis appeared rather suddenly together with cerebrospinal rhinorrhea and headache. The onset of these symptoms probably coincided with the rapid entrance of air into the frontal lobe. In view of the symptoms of increased intracranial pressure and the likelihood of progressive destructive effect of the air that is trapped within the cerebral tissue, operation should not be delayed in these cases.

In addition to intracerebral and intraventricular pneumatocele, gas may occur in the subarachnoid and subdural spaces. Dandy has stressed the fact that another factor besides the existence of a pathway from cranial sinuses to cranial chamber which is necessary for the development of pneumocephalus to occur is "increased pressure of air within the cranial sinuses such as is produced by sneezing, coughing, straining or possibly even swallowing." In this connection, it is of interest that the patient whose roentgenograms are reproduced in Figure 2 suffered from hay fever during which violent sneezing spells occurred. It is probable that this condition precipitated the onset of his symptoms. Dandy has produced evidence to show that a "channel may be patent for fluid and not for air."

Cerebrospinal otorrhea differs from rhinorrhea in that it does not appear to persist. If, however, cerebrospinal otorrhea were persistent, in view of the serious potentiality of intracranial infection which would exist, one would be obliged to undertake operative repair with the use of a facial transplant such as is done in the case of cerebrospinal rhinorrhea.

The mortality rate in untreated cases of pneumocephalus is considered to vary from 40–50 per cent,[5] infections or increased pressure being the causes of death. With the use of the sulfonamide drugs, the outlook in cases of cerebrospinal rhinorrhea and otorrhea, so far as this dreaded complication of meningitis is concerned, is considered favorable.[6] However, prophylactic treatment with sulfadiazine was ineffectual in our case in preventing meningitis, just as in combination with penicillin therapy it was of no avail after the infection had appeared. It is possible that large doses of sulfadiazine may have resulted in higher blood levels for the drug and hence prophylactic success. Nevertheless, it would appear to be advisable in cases of cerebrospinal otorrhea or rhinorrhea to use immediately a combined prophylactic treatment of penicillin and sulfadiazine for intracranial infection.

SUMMARY AND CONCLUSION

A case of fracture through the petrous portion of the temporal bone is described in association with cerebrospinal otorrhea and spontaneous pneumocephalus. Meningitis occurred in spite of prophylactic sulfadiazine therapy which in the future treatment of such cases should be combined with penicillin. Autopsy findings indicated that the air, after entering the subarachnoid

space from the mastoid sinus or the middle ear, must have gained access to the ventricular system by normal channels.

The intraventricular pneumocephalus was disclosed in the course of routine roentgenograms of the skull, and the patient complained of no headaches or other symptoms at this time. Moreover, the cerebrospinal otorrhea was very slight and might easily have been overlooked. In view of the potential seriousness of the condition of pneumocephalus when it exists and the importance of instituting early and adequate prophylactic treatment for infection, roentgenographic examination should not be delayed unnecessarily in these cases.

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We are indebted to Dr. T. Weinberg, Chief of the Department of Radiology, Metropolitan Hospital for his interest and help in the roentgenological studies of the cases illustrated in Figures 1 and 3.

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Vol. 56, No. 2

CONGENITAL TALONAVICULAR SYNOSTOSIS ASSOCIATED WITH HEREDITARY MULTIPLE ANKYLOSING ARTHROPATHIES*

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IN 1879 Anderson[1] reported the first case of bilateral congenital talonavicular synostosis. In 1943 O'Donoghue and Sell[5] reported the second case, illustrated with roentgenograms and also mentioned five unilateral talonavicular fusions previously reported in the literature. Boyd[2] reported 4 cases in 1944. One was a girl, ten years of age, and the other 3 cases were in one family—grandmother, father, and a son of ten. All these cases were bilateral synostosis of the talus and navicular bones.

CASE REPORT

The patient was a soldier, aged twenty-three, two and a half years in the Army, one of eleven children—eight boys and three girls. He complained of pain and discomfort in both feet, insidious in onset. He has no swelling or visible deformity. Eversion and inversion of the feet are limited. The roentgenological examination of both feet revealed normal calcaneus. The tali are broader than normal and articulate with all three cuneiform bones and the calcaneus and the cuboid. The third cuneiform is in synostosis with the third metatarsal. The left foot reveals a very large os tibiale externum which is protruding medially into the soft tissues, corresponding to the site of pain. The right foot shows, at the same region, bulging indicating a fusion of the os tibiale externum with medial distal portion of the combined bones. The right calcaneocuboid articulation shows slight lipping and spur formation, due to the presence of an osteoarthritis, which might have been caused by the absence of the talonavicular articulation increasing the strain on the right calcaneocuboid joint. Each hand presents synostosis between the first and second phalanges of the fourth and fifth fingers and between the navicular and greater mult-

FIG. 1. Anteroposterior composite view of the right foot shows the fusion of the talus and os naviculare pedis. There is an osteoarthritis at the calcaneocuboid articulation.

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Fig. 2. Anteroposterior composite view of the left foot shows the fusion of the talus and os naviculare pedis and the presence of os tibiale externum, bulging medially into the soft tissues, causing pain.

angular of both wrists. The patient states that his father has the same deformity of the hands.

The structures[3] of the peripheral joints are derived from the mesoderm. As early as the third week of intrauterine life, the future bones and joints can be distinguished as scleroblastema, extending from the vertebral column as axial rods in the limb buds. During the fifth and sixth weeks, because of condensations of cells and the lack of cell multiplication between these portions, the cores develop the appearance of chains of mesenchymal links. The condensed cellular structures are the progenitors of the bones and the loose intersegmental tissues develop into the joints.

The lack of development of mesenchymal cords, which are the progenitors of these bones, will result in the absence of the cuneiforms, second metatarsal, phalanges and fibula. The result is deformity, abnormal weight-bearing and static osteoarthropathy. The condensation of mesenchymal cells, without segmentation, results in absence of joint formation, which is de-

Fig. 3 (below). Oblique view of left foot showing the synostosis between the third cuneiform and the third metatarsal bone.

scribed as synostosis. The three phalanges of a finger may be fused as one.

Variations of the tarsus are ununited centers of ossification producing (1) vesalanium, (2) trigonum, (3) peroneum, (4) epinaviculare, (5) accessory talus, (6) os sustentaculum and (7) os tibiale externum. They vary in number, in appearance, and in size. These accessory bones develop in childhood and later some of them show tendency of unification with the respective tarsal bones.

In this case, the os tibiale externum, which can be found in 10 per cent of the people, developed in one foot only and reached a giant size which obviously is the reason of his discomfort. The blood supply to the navicular bone is the poorest of all the tarsal bones.[4] This bone is the last one to ossify and it is considered the step-child among the bones of the foot. Due to the synostosis, the limited metatarsal blood supply is diverted to the os tibiale externum, causing its giant size and consequently the discomfort.

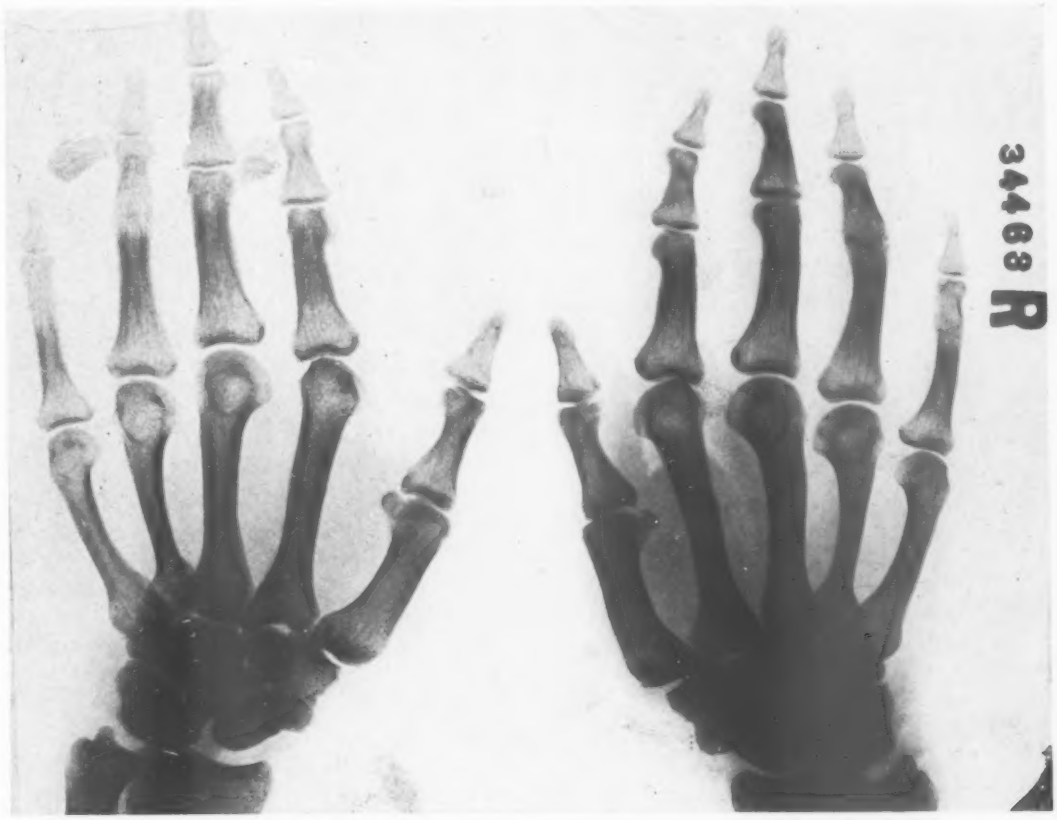

Fig. 4. Both hands present synostosis between the first and second phalanges of the fourth and fifth fingers and between the navicular and greater multangular.

SUMMARY

A case of bilateral congenital synostosis of the talus and navicular, with hereditary multiple ankylosing athropathy of the hands and wrists, is presented and illustrated by composite roentgenograms. A short embryological aspect of joint development is outlined.

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THE PATHOGENESIS OF CHARCOT'S JOINT

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IN 1868, Jean Martin Charcot,[4] lecturing at La Salpêtrière on the joint conditions which appeared to accompany lesions of the central nervous system, drew attention to one he called "the ataxic form"—not previously described with any clarity—and in which the affected joint first gave evidence of an acute and unheralded effusion which left in its wake varying degrees of swelling and instability.

Charcot's enumeration of the findings and his careful analysis of the predisposing causes were the first to be presented with sufficient assurance to delineate as a clinical entity the neuropathic joint—the classical "Charcot joint" of tabes dorsalis—the one which, before the advent of roentgenograms became familiar to each generation of medical students as that in which there was the feeling of a "bag of bones."

Since Charcot's pronouncements met with almost instant disagreement, particularly from the famous German surgeon Volkmann, it may be of interest to review the text of them:

> . . . Without any appreciable external cause we may see, between one day and the next, the development of a general and often enormous tumefaction of a member, most commonly without any pain whatever, or any febrile reaction. At the end of a few days the general tumefaction disappears, but a more or less considerable swelling of the joint remains, owing to the formation of a hydarthus; and sometimes to the accumulation of liquid in the periarticular serous bursae also. On puncture being made, a transparant lemon-colored liquid has been frequently drawn from the joint.
>
> One or two weeks after the invasion, sometimes much sooner, the existence of more or less marked cracking sounds may be noted, betraying the alteration of the articular surfaces which, at this period, is already profound. The hydarthus becomes quickly resolved, leaving after it an extreme mobility in the joint. Hence consecutive luxations are frequently found, their production being largely aided by the wearing away of the heads of the bones which has taken place. I have several times observed a rapid wasting of the muscular masses of the members affected by the articular disorder. . . . Besides the wearing down of the articular surfaces . . . you may notice the presence of foreign bodies, of bony stalactites, and, in a word, of all the customary accompaniments of arthritis deformans. The latter alterations were absolutely wanting in the first case (post-hemiplegic). On this account I am led to believe that they are nowise necessary and that they are produced in an accidental manner, and to all appearances chiefly by the more or less energetic movements to which the patient sometimes continues to subject the affected members. . . .

Now, as to Charcot's views on the pathogenesis of this sort of joint, and referring again to his original article:

> The arthropathy of the ataxias . . . seems always later in time of appearance than the sclerotic changes in the spinal cord. I am even inclined to believe that they are subordinate to them, as it were . . . . It would be impossible to invoke, for the sake of proving a certain doctrine, a participation of the roots and of the lumbar spinal ganglions.

The "certain doctrine" to which he referred was that of Volkmann: the eminent German surgeon had almost immediately disagreed violently with Charcot's postulated rôle of the spinal cord itself in the production of joint changes which must have been, if one had followed Charcot unquestioningly, of a "trophic" nature.

Volkmann took the position that the spectacular joint changes were mechanical in origin—mechanical in the sense that they originated in a multiplicity of subclinical traumata which went unperceived because of the insensitivity of the affected joints.

Charcot treated Volkmann's contentions with a smile, and never devoted long to dismissing them. Volkmann, nevertheless, had a following; and when Virchow entered the controversy, throwing his influence entirely on Volkmann's side, their mechanical theory began to be known as the "German theory," while Charcot's concept of a trophic joint became known as the "French theory."

ETIOLOGIC CONSIDERATIONS

Perhaps the greater number of roentgenologic textbooks, in their introductory remarks on the neuropathic joint, refer to it as one observed in tabes, and sometimes in syringomyelia. Rather seldom are other causes touched upon, and the fact that Charcot himself described injury to the spinal cord as an etiologic factor elicits only an occasional comment.

While it is doubtless true that tabes and syringomyelia should receive first consideration in dealing with the etiologic factors, one must also recognize a large number of other conditions in which a typical neuropathic joint may be evolved: trauma to the spinal cord, trauma to posterior roots, cord tumors, congenital malformations (as spina bifida), spinal caries from tuberculosis, malignant tumor or other destructive process, acute myelitis, poliomyelitis, leprosy, toxic neuritis, and hemiplegic states.

Steindler[41] calls attention to the fact that J. K. Mitchell in 1831 pointed out the connection between cord lesions and certain joint diseases; tabes was added by Charcot in 1868, myelitis by Weir Mitchell in 1875, anterior poliomyelitis by Laborde in 1873 and syringomyelia by Sokoloff in 1892, the latter reporting 20 cases from the literature and adding 3 of his own, the oldest case being that of Blasius in 1848.

Israel,[19] reporting a case of neuropathic joint following a shrapnel wound of the spine, cited earlier similar cases from the literature: Riedel in 1883 had described a neuropathy involving a knee, associated with a hemiparalysis, and resulting from a knife wound of the back; Chipault had described a case due to hematomyelia. Duncan[11] described an interesting case in which a lumberman forty-two years of age suffered an injury to the posterior spinal roots as a result of a blow from a falling log. The anterior motor roots were unaffected and the patient was able to use his arm. His right arm was swollen from shoulder to wrist; the shoulder joint space showed tremendous widening, the radius and ulna were hypertrophic and the carpus was disorganized. There was definite anesthesia throughout the length of the extremity.

On September 29, 1941, there was admitted to the West Suburban Hospital N. A., male, aged twenty-nine. He was brought in for a preliminary roentgenogram of the abdomen; since he presented symptoms of urinary sepsis, the film was ordered in a search for calculus.

The outstanding findings in the roentgenogram were with reference to the right hip, and, to a lesser extent to the spine. The history given by the patient was that fifteen years ago he had been thrown from an automobile, fracturing his spine at the level of the first lumbar vertebra; and that since that time, as the patient stated, "he had been paralyzed from the waist down."

Examination revealed loss of motor and sensory function in both lower extremities; there was saddle anesthesia, and further history revealed evidence of atony of bladder and rectum. The right hip was large and irregular in contour, with a tremendous bony overgrowth involving most of the articular structures.

Further roentgenograms were made for bone detail; they are shown in Figures 1 and 2. When one surveys the enormous and purposeless bone production involving all the structures of the right hip joint, the huge and hypertrophic shelf of new bone which has been thrown out from the acetabulum, the grotesque distortion of the trochanters, and the osteosclerosis which invades the innominate bone well up into the ilium, this articular monstrosity seems to defy classification into any other group than that of the joint neuropathies.

PROBLEMS IN PATHOGENESIS

Most textbooks, not only of roentgenology but of orthopedics and neurology,

briefly denominate all the neuropathic arthropathies as "trophic disturbances"—ascribing to them a common origin with the familiar perforating ulcers so often seen on the feet of tabetics.

This was the explanation which suggested itself to Charcot, and the one to which he clung, despite the vigorous objections of Volkmann and the scholarly dissensions of Virchow. The utter disorganization which these joints undergo, the

FIG. 1. Hip of patient suffering from biplegia of fifteen years' duration, the result of lumbar spine fracture. The left hip is virtually unchanged save for a few osteophytes along the superior border of the inferior ramus of the left pubic bone. The right hip shows changes characteristic of a neuropathic joint; there is no disarticulation, since there has been no weight bearing. Repeated turning of the patient on his right side for nursing care is considered the "traumatic" factor (Volkmann) which has produced the grotesque periarticular changes. The spine shows a suggestively increased density.

lavish and purposeless production of new bone which appears about the articular areas, the great amount of osseous debris which accumulates all about the articulation certainly suggest, with the utmost logic, that here one is viewing such an alteration of nature's ordinary processes as could only take place in the presence of a most profound disturbance of regional nutrition.

As Duncan[11] puts it: "There is here an analogy to an insensitive tooth. It is essen-

FIG. 2. Both of these hips (tabetic in origin) show a similar tendency to lavish production of new bone, though here the etiologic factor is quite different from the one operating in the case shown in Figure 1. Both Figures 1 and 2 illustrate what is usually referred to as the hypertrophic form of the arthropathy. It is to this sort of new bone production that Israel gave the name "kallus luxurians." Here, in contrast to Figure 1, there is disarticulation, the result of weight bearing.

tial that every organ receive not only an adequate supply of blood, but also maintain constant communication with the central nervous system. This it does through efferent and afferent nerves. The simplest reflex might be thought of as involving the

FIG. 3. Here is well illustrated the "atrophic" form of tabetic arthropathy. The femoral heads have disappeared on both sides, producing the "drumstick" femur of the French writers; a "wandering" acetabulum is evident bilaterally. Along the inner margin of the upper third of the left femur is exemplified the "myositis ossificans neurotica" of Israel.

Fig. 4. A neuropathic arthropathy of the elbow—the rareness of which, in tabes, has been emphasized by Warfield. The external condyle, rarefied and osteoporotic, has been fractured; the olecranon fossa and the internal condyle show sclerotic condensation and early osteophyte production, as does the upper end of the ulna, adding a bit of consistent evidence in support of the "traumatic" theory. Charcot elbows are much more common, relatively, in syringomyelia than in tabes.

sensory end organ, its fibers and cells in the spinal ganglion with a central branch arborizing around an anterior horn cell from which arises the motor nerve conveying an efferent impulse to distant muscle. However, the average reflex is much more complicated, one relay after another of nerve cells and fibers being employed, some peripheral, some spinal and some cerebral." Duncan goes on to point out a similarity between a devitalized tooth and a joint which has been robbed of its nerve supply, or of a portion of its nerve supply, stating that the changes seen in the surrounding areas in either case may be atrophic or hypertrophic in character; the result, he concludes, of a severance of the nerve supply to a part, from its central connections.

The question has repeatedly arisen as to just what nerves may be "trophic" nerves; where they run, what their relationship to the sympathetic system may be, whether or not they have separate and distinct centers in the spinal cord. Lafora[24] does not hesitate to commit himself rather definitely on the question of trophic centers: "The trophic medullary centers are situated near the sympathetic centers in the lateral horns in the dorsal cord and in the gelatinous substance of the lumbar cord." Few others, however, share Lafora's confidence, the

Fig. 5. Anteroposterior view of an arthropathy of the knee developing in a tabetic; note the exuberant and purposeless production of new bone, the origin of which was so much clarified by Steindler's painstaking researches.

statement being much more frequently made that we have no definite knowledge of the existence either of trophic centers or of trophic nerves, and Eloesser[13] appearing to substantiate such a statement with some very convincing experimental evidence.

Marinescu[29] believes that the sympathetics, per se, might be operative in the production of changes referred to as "trophic;" he points out that reactions to histamine and to adrenalin carry a certain weight of evidence in that they are sharper on the side of the neuropathy; concluding from this that vasomotor phenomena play a part, not only in the development of articular changes, but in the enormous bony overgrowth involving the periarticular soft parts.

Fig. 6. Lateral view of the same knee shown in Figure 5. Note the "stalactite" of Charcot's original description, at the upper end of the tibia. Enormous production of extra-articular osteophytes. Similar osteitic excrescences, to some extent fractured, have appeared at the upper and lower ends of the patella; for this sort of ossification, Potts uses the term "parosteal new bone."

Fig. 7. A Charcot wrist (etiology, tabes). Degenerative changes in the carpus, dislocation at radiocarpal joint. Early new bone production all about the articulation; increased density in the lower end of the radius, ossifying periostitis, increased soft tissue density. History of intermittent hydrarthrosis.

Hildebrand[18] advances a similar argument in discussing a neuropathic hip joint. Trophic changes, he asserts, are observed with equal frequency in central and peripheral lesions; the "neural nutrition" of a part must not be interfered with; it may involve bone, muscle or skin.

On this question Nielsen[30] says:

The question of trophic disturbances has never been settled. For many years it has been recognized that the life of an axon depends on its continuity with the cell body, and that in lesions of the lower motor neuron atrophy oc-

Fig. 8. A Charcot ankle (tabes). Above the destructive changes which may be seen at the lower tibial articular surface is dense sclerosis, and excessive new bone production, especially evident in the lateral view. The chief involvement is, of course, at the tibiotalar joint; one can, however, predict that the subastragaloid joint may soon show an increase of changes already evident.

curs not only in the muscles but in the deeper structures as illustrated by the cessation of growth or actual atrophy of bone in acute anterior poliomyelitis. This, however, is not the entire answer. It has also been known since the demonstration of von Monakow (thirty years ago) that lesions of the parietal lobe of the cerebrum cause early atrophy of the opposite side of the body. Severe trophic disturbances are the rule in complete transections of the cord.

The same author goes on to cite evidence that trophic disturbances often may not occur unless the vegetative nervous system is diseased or injured. The trophic lesions of tabes and syringomyelia, especially the perforating ulcers, the ureteral and vesical disturbances of tabes, progressive facial hemiatrophy, scleroderma, the trophic lesions of polyneuritis, especially arsenical, all occur in diseases in which the vegetative fibers are affected. In acute anterior poliomyelitis the lateral horns of the spinal cord are affected almost as severely as the anterior horns, and in the cases of severe trophic disturbances postmortem examination shows a severe involvement of the lateral horns of the affected areas.

In section of the afferent root or ganglion of the trigeminal nerve, Nielsen states further, trophic disturbances of the eye are a source of great clinical trouble, but if the section is made in the medulla (tractotomy) behind the point at which the sympathetic

fibers join the fifth nerve, trophic lesions do not occur. It is true, he continues, that section of the sympathetic trunk in man is not followed by trophic disturbances; it seems that connection with the vegetative centers of the spinal axis is the essential element which prevents the trophic lesions, dissociation from the periphery the essential element which causes them. Nielsen quotes Archambault and Fromm to the effect that while the vasomotor fibers are not trophic fibers in themselves, they may very possibly run with such trophic fibers.

In dealing with the various lesions of syringomyelia which are grouped as "trophic," Grinker[16] calls attention to the hardening and thickening of the skin of the affected parts, the coarseness and arrest of growth in nails, the formation of indolent ulcers on the fingers, usually after an unperceived burn. Cigarette smokers frequently char and burn themselves, not feeling the heat from the cigarette in their fingers. Occasionally, spontaneous amputation of the distal portion of a finger occurs, due to the profound trophic changes. These, he points out, seem to be referable to the absence of normal pain and temperature sensation, permitting the injury to occur in the presence of a damaged vasomotor system which delays healing. (Is there not, here, a restatement of the essential portion of Volkmann's original contention?) And further, in the type of syringomyelia known as Morvan's disease—"The anesthetic and analgesic extremity is prone to develop

Fig. 9. Here the new bone production in no way approaches that seen in Figure 6. There are numerous intra-articular osteophytes, total disorganization of one articulation, partial disorganization of the other.

painless felons or whitlows which almost never heal, and completely destroy the phalanges involved. The vasomotor changes in Morvan's disease, and the gangrene, show a great resemblance to Raynaud's disease and it is interesting to note that one theory ascribes this latter disease to a lesion of the lateral gray columns."

Grinker makes clear that in his opinion the presence of special trophic fibers has by no means been proved. He quotes Tower, who showed experimentally that striped muscle is morphologically not at all affected by sympathectomy. What does occur is secondary change in the skin and subcutaneous tissues through alterations of the nerve supply to the blood vessels.

In 1917 Eloesser[13] did a most important piece of work in the attempt to dispel some of the ambiguity which had continued to cling about the entire etiologic concept of the Charcot joint; his approach was most analytical, his efforts long continued and painstaking, and his work has been widely quoted.

In the publication of this work, he began with the following declaration:

> We are no further in our knowledge of the joint lesions [of tabes] than we were twenty-five years ago. The best expositions of the subject date back to that time; more recent ones have added nothing new and have often left out of consideration facts of importance.
>
> Do the nerves exert some mysterious "trophic" influence on the bone or will an alteration of the normal warning sense of pain suffice to explain the occurrence of osseous affections? Barth asked how we could hope to explain a neuropathic deforming arthritis when we did not even know the nature of an ordinary one.

Eloesser then cut a series of posterior roots, in cats, so as to ablate the sensory supply to a particular extremity, enough of them to make a total analgesia, anesthesia and ataxy. In this series, some of the cats developed Charcot's joints.

He produced joint changes in another series of animals, and, after waiting some time, cut the posterior roots; in the next series he reversed the process, cutting the roots first, waiting, and then inducing a deforming arthritis. The cutting of the posterior roots appeared to have no appreciable effect on the amount of existent deformity in the cats with arthritis.

He then resected posterior roots in three cats, opened the joints and seared a spot on the femoral condyles with a thermocautery. Within three weeks, every cat thus treated developed a Charcot joint, with hydrops, deformity, and grating of joint surfaces. He goes on to say:

> This was, then, not a slow aggravation of a pre-existing deforming arthritis; it was the sudden response of an anesthetic joint to the acute trauma of operation, a rapid reaction to bone injury by the production of the typical Charcot joint.

Attention is called to the fact that most of the Charcot joints are seen in early tabes —in patients still ambulatory and capable of inflicting the requisite trauma on a joint —in patients till ambulatory and capable of inflicting the requisite trauma on a joint recently become insensitive.

Soto-Hall and Haldeman,[19] Steindler,[41] Potts,[32] Barth,[1] and others, have given excellent descriptions of the pathologic changes which take place as a neuropathic joint develops. The primary pathologic process is a degeneration and partial disappearance of the joint cartilage, which is invaded by a fibrous connective tissue from the pannus on its surface. In certain areas the zone of preliminary calcification is exposed by the stripping away of cartilage.

Beneath this zone there may be a proliferation of cartilage which becomes converted into subchondral bone, thus accounting for the sclerotic, eburnated bone seen at the base of large defects in the articular cartilage. A generalized atrophy of the trabeculae of the cancellous bone is often seen. In one instance a perivascular infiltration of lymphocytes was observed, though in the capsule of the knee joint this is a rare finding.

When well established, the lesions are quite typical. Two types of osteophytes are

Fig. 10. Some evidence of an effusion still persisting in the knee which has partially retained its articulation; the other illustrates very well Kienböck's expression "arthrosis deformans hypertrophica simplex."

usually seen. The first is a loose, detached bone fragment which may seem to be the result of recent fracture. Some such fragments become attached to the bone and grow, in an amorphous, purposeless fashion. Some, especially in the spine, seem to serve a purpose in that they bridge an interspace and lend support where instability is becoming marked.

In the spine, these osteophytes begin at the articular margins and resemble greatly the hypertophic form of arthritis, but are usually larger than those seen in the latter condition. Within an affected vertebral body the bone is usually denser as from a calcareous infiltration. The osteophytes themselves are usually of good osseous integrity.

Both atrophic and hypertrophic forms of neuropathic arthropathy may be met with: in the former, relaxation of ligaments and displacement of articulating surfaces prevail; in the latter, proliferative changes attract attention. Intra-articular and extra-articular osteophytes, exostoses, ossification of muscles and ligaments; joint cartilage ossification and marginal lipping at contact points, to be followed later by defibrillation of superficial and eburnation of deep layers, and destruction and resorption of the joint bodies, both intra-articular and extra-articular.

In the hip a "wandering" acetabulum may be encountered, and the femoral head may be lost by attrition, with part of the neck, producing the "drumstick head" of the French authors. The acetabulum may be perforated, with so-called "central dislocation" of the head of the femur.

Microscopically, cartilage may be lost in places, covered by vascular and cellular connective tissue, a form of pannus, while in the depths there is an abnormal proliferation of cartilage cells with formation of new cartilage islands. The spongiosa is of irregular structure, the spaces between the

Fig. 11. A Charcot spine. Marked increase in sclerotic density noted in the involved vertebrae, deformity of vertebral bodies, decrease in joint space between the fourth and fifth lumbar vertebrae. On the right, such marginal lipping as to justify the French expressions "bec de perroquet" and "foyer."

lamellae are filled with cellular and vascular connective tissue and contain giant cells similar to those seen in giant cell tumors; but whether these are osteoblastic or come from the endothelium of the blood vessels or from fibroblasts is not determined.

In the cartilage, vacuoles are observed, but these are secondary regressive changes and precede the transformation of cartilage into connective tissue. Destruction of cartilage is accompanied by destruction of underlying spongiosa with the formation of large crevices and defects. Bone absorption is carried out by giant cells; never is necrosis found.

The destruction and absorption of cartilage occur from the pannus above and from the spongiosa below; in this way hollow spaces, called the Weichselbaum lacunae, are formed, and the cartilage becomes honeycombed.

The particularly characteristic point for the neuropathic arthropathies is that the endochondral ossification under the joint cartilage, which ordinarily becomes stationary with formation of a continuous limiting bone lamella, the so-called preliminary calcification zone is now becoming extensively revived. The first step of this revival is the proliferation of the joint cartilage. The second step is a forward pushing of the preliminary calcification zone, and the third step is a penetration of vascular marrow recesses into this zone and then into the now calcified cartilage.

The joint reacts on all occasions with the resumption of endochondral ossification. *The degree of this ossification is so great and so diverse, that, by dint of simultaneous absorption and proliferation an enormous incongruity of the joint surfaces may result.* (Steindler)

Relative to the case which I have described above, in which a neuropathic joint developed in a patient who for fifteen years had been bedfast, the question might be asked as to the source of "trauma," if trauma is to be accepted as the activating force in the production of the new bone seen about the acetabulum and trochanters; the answer is to be found in the fact that during most of this prolonged period of inactivation the patient had, as a matter of habit, been turned on his right side for nursing care. The continued pressure of the body weight may be seen to be quite adequate as a source of trauma in an insensitive joint, if one reflects that the "trauma" ordinarily suffered consists in no more than that received in ordinary locomotion—in the physiologic use of a joint.

CONCLUSIONS

1. There is no definite evidence of the existence of "trophic" nerves.

2. The changes observed in neuropathic arthropathy appear to be brought about by repeated subclinical traumata occurring in an insensitive joint.

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Vol. 56, No. 2

A NEW SERIES OF RADIOPAQUE COMPOUNDS*

I. CHEMICAL STRUCTURES, CHANNELS OF EXCRETION AND ROENTGENOGRAPHIC USES†

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(CLINICAL AND ROENTGENOLOGIC ASPECTS)
SAMUEL NATELSON, PH.D.
and
BENJAMIN KRAMER, M.D.
(CHEMICAL ASPECTS)

THIS communication presents a hitherto unreported series of compounds which have the physiological properties of being excreted through the liver and biliary tract and the kidneys. By virtue of the iodine constituent of the various members of the series roentgenographic visualization of the gallbladder, the urinary bladder and to a slight degree the kidney pelvis and calices may be obtained in varying degrees of intensity. The entire series is nontoxic and is readily tolerated by the human organism without any unpleasant reactions.

The two compounds now used for oral cholecystography are tetraiodophenolphthalein[3] and beta (4-hydroxy-3,5-diiodophenyl)-alpha-phenyl-propionic acid.[4,8] Another compound, diiodo-atophan, was used for a short time but was discarded because of toxicity.[6] Tetraiodophenolphthalein, commonly used as its sodium salt, is often accompanied by gastric irritability and has cathartic properties which may distress the patient, and unabsorbed particles may remain in the gastrointestinal tract resulting in disturbing roentgenographic shadows. However, it is an efficient compound and produces adequate gallbladder visualization. The propionic acid derivative, which is used as the free acid, is better tolerated and likewise is efficient for gallbladder roentgenography. However, untoward systemic reactions such as diarrhea, intestinal cramps and burning on urination have been encountered after oral administration.[7] Intravenously it is a convulsant drug and has resulted in death in doses varying from 100 to 200 milligrams per kilogram of body weight in cats.[5]

A review of the chemical structure of the reported oral cholecystographic compounds suggested to one of us (S. N.) that a series of compounds might be evolved which would combine adequate gallbladder visualization with minimal or no toxic side reactions. The optimum requirements for such compounds were considered to be the following:

1. The compounds should have a molecular structure which is borne to the liver. Such a group would be the phenolic group, which is known to be detoxified in the liver either as the sulfate ester or the glucuronide, and which is a product of normal body metabolism.

2. The molecule should contain a carboxy group so that the sodium salt may be formed to facilitate the solution of the compounds in bile.

3. The molecule should have an iodine content sufficient to render it radiopaque in the quantities present in the gallbladder.

4. The compound should be fat soluble so that it would pass through the liver and gallbladder rather than through the kidney as would occur with water soluble compounds. To achieve this fat solubility it was decided to use an iodinated aromatic nucleus with aliphatic side chains.

It was also decided that the number of

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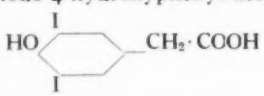
phenyl groups be kept to a minimum inasmuch as these are sources of physiological toxicity. Tetraiodophenolphthalein contains three phenyl groups, two of which bear two iodine atoms each, and beta (4-hydroxy-3,5-diiodophenyl) alpha phenyl propionic acid contains two phenyl groups, one of which carries the iodine atoms. In diiodo-atophan a quinoline nucleus is present which renders the compound sufficiently toxic to be unusable for clinical purposes.

Iodinated parahydroxyphenylacetic acid was chosen as the initial compound of our series because it fulfilled all the criteria set forth. Inasmuch as there is but one phenyl group in the compounds their toxicity is low. Furthermore, the iodination of the phenolic group renders it even less toxic. An example of the effect of iodination is exhibited by phenolphthalein, which is tolerated by man in grain doses, while tetraiodophenolphthalein may be taken in doses two hundred times as large. The hydrocarbon side chains in the series are completely nontoxic.

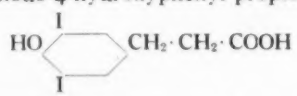
The initial compound, 3-5-diiodo-4-hydroxyphenylacetic acid, is a derivative of parahydroxyphenylacetic acid, which is a normal degradation product of tyrosine derived through deamination and oxidation.[2] As long ago as 1882 Baumann[1]

TABLE I

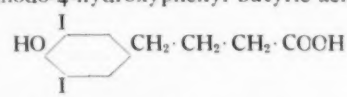
1. 3-5-diiodo-4-hydroxyphenyl acetic acid



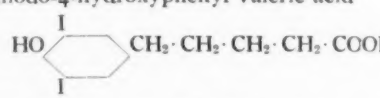
2. 3-5-diiodo-4-hydroxyphenyl propionic acid



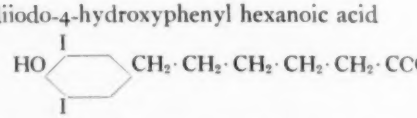
3. 3-5-diiodo-4-hydroxyphenyl butyric acid



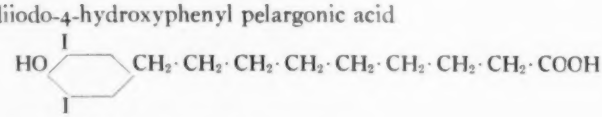
4. 3-5-diiodo-4-hydroxyphenyl valeric acid



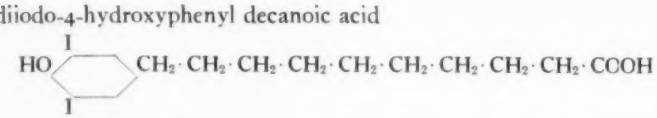
5. 3-5-diiodo-4-hydroxyphenyl hexanoic acid



6. 3-5-diiodo-4-hydroxyphenyl pelargonic acid



7. 3-5-diiodo-4-hydroxyphenyl decanoic acid



8. 3-5-diiodo-4-hydroxyphenyl undecanoic acid

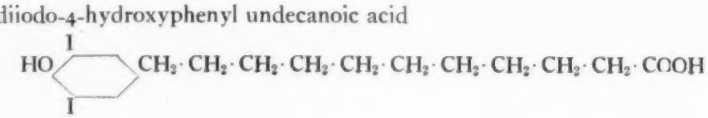
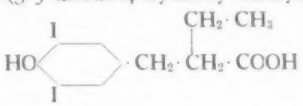
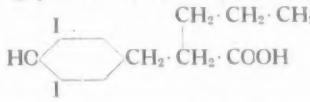


Table I—(*continued*)

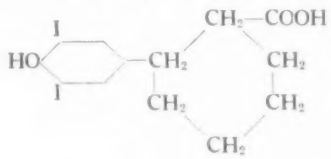
9. alpha-(3-5-diiodo-4-hydroxy-benzyl) butyric acid



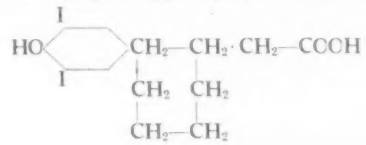
10. alpha-(3-5-diiodo-4-hydroxy-benzyl) caproic acid



11. 3-5-diiodo-4-hydroxyphenylcyclo-hexanoic acid



12. 3-5-diiodo-4-hydroxyphenylcyclohexylacetic acid



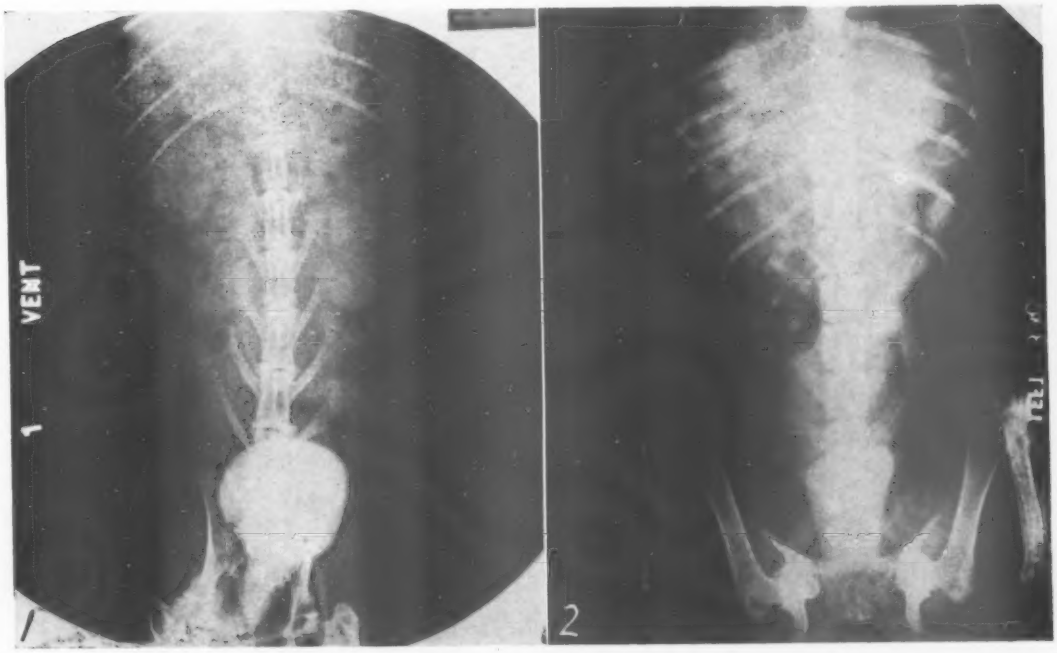


Fig. 1. Roentgenogram of the abdomen of a rabbit two hours after the intravenous injection of 500 milligrams of 3-5-diiodo-4-hydroxyphenylacetic acid. The urinary bladder is sharply visualized. The gallbladder is not visible. There were no untoward reactions.

Fig. 2. Roentgenogram of the abdomen of a dog weighing 3 kilograms six hours after the intravenous injection of 3 grams of 3-5-diiodo-4-hydroxyphenylacetic acid. Both the gallbladder and the urinary bladder are well visualized; there were no untoward reactions.

isolated 500 milligrams of this compound from 25 liters of normal human urine. Tyrosine is one of the essential amino acids present in all complete proteins.

In developing this series of compounds all the subsequent members were constructed as homologues of iodinated parahydroxyphenylacetic acid. A homologue is a compound which differs from the adjacent members of the series by a change in molecular weight of CH_2. As a rule the progressive lengthening of an aliphatic chain increases its oil solubility and its chemical inertness, and decreases its water solubility.

A series of thirty-one such iodinated compounds was prepared, of which twelve were selected for further study.[9] With the exception of parahydroxydiiodophenylpropionic acid, all these compounds have never been reported before. The twelve selected were chosen because of their ease of preparation and low cost. As will be noted in Table 1 the first eight members are straight aliphatic chain compounds containing from two to eleven carbons. The remaining four compounds contain the carbons in branched and cyclic side chains. Absolute purity of the compounds is essential in avoiding any unpleasant systemic reactions.

We made a study of the available experimental animals for evaluating gallbladder opacifying compounds with interesting results. Chicks, rabbits, frogs and dogs were used. The first three were unsatisfactory inasmuch as their gallbladders did not visualize with any compounds including our own. Although results with dogs were rather difficult to evaluate, they were fairly satisfactory. We found that the short chain members of our series visualized dog gallbladders better than human gallbladders, while the longer chain members

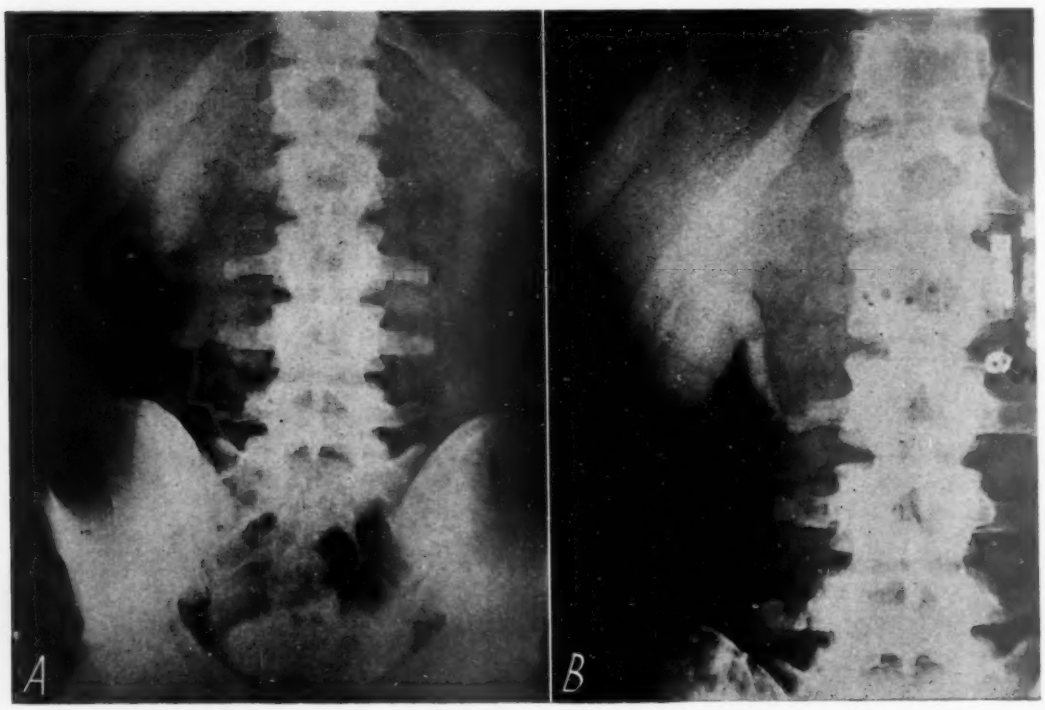


FIG. 3. *A*, roentgenogram of the abdomen of an adult male volunteer eight hours after the oral ingestion of 3 grams of 3-5-diiodo-4-hydroxyphenylacetic acid. Both the gallbladder and the urinary bladder are fairly well visualized, and the left renal pelvis is faintly outlined. There were no systemic reactions. *B*, roentgenogram of the right upper abdomen of the same patient taken ten minutes later. The right renal pelvis and upper ureter are well visualized. The calices are obscured by the opacified gallbladder.

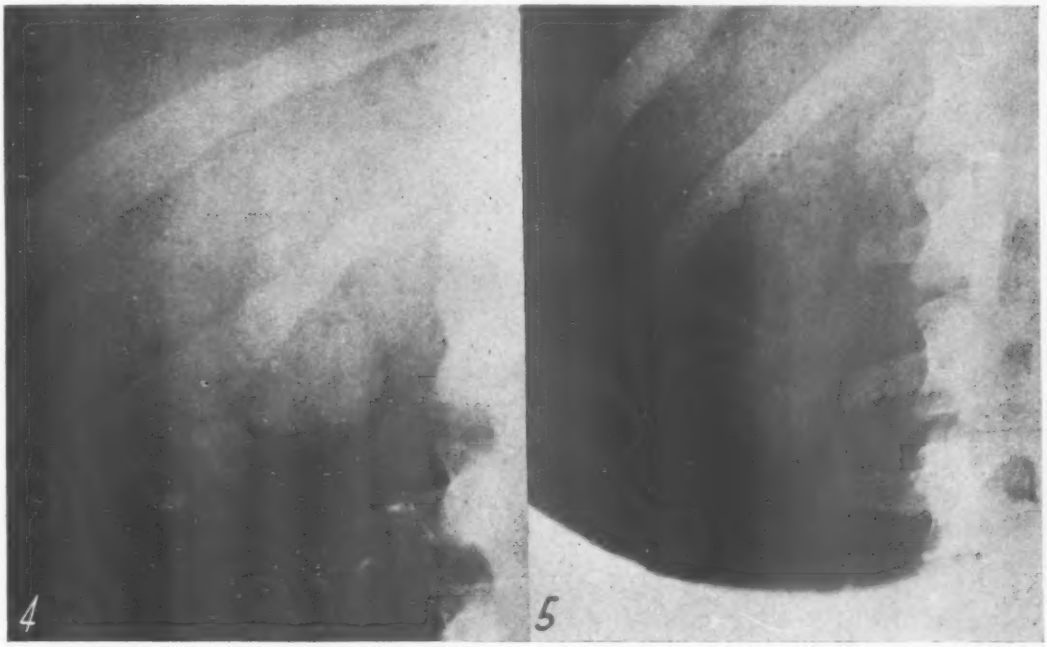


Fig. 4. Roentgenogram of the right upper abdomen of an adult male volunteer twelve hours after the oral ingestion of 3 grams of 3-5-diiodo-4-hydroxyphenylundecanoic acid. The gallbladder is fairly well visualized. Unabsorbed particles persist in the hepatic flexure. There were no systemic reactions.

Fig. 5. Roentgenogram of the right upper abdomen of an adult female volunteer twelve hours after the oral ingestion of 3 grams of 3-5-diiodo-4-hydroxyphenylbutyric acid. The gallbladder is fairly well visualized. There were no systemic reactions.

visualized human gallbladders more intensely than canine gallbladders. It is important in considering this experimental work on dogs to recall that the canine gallbladder lies high and close to the midline, and is often obscured by the spine. Oblique and lateral roentgenograms may be necessary to visualize this structure. Ultimately we tested the various compounds on dogs and rabbits for evaluating toxicity, and relied on human volunteers for evaluating the compounds for use in diagnostic procedures.

All the compounds in this series were found to be free from untoward physiological reactions in oral doses varying from 3 to 9 grams. All the compounds were given intravenously to rabbits in doses of 500 mg. per kilogram body weight without ill effect. Three grams of diiodoparahydroxyphenylacetic acid were given intravenously to an 8 pound dog without ill effect. A 2.5 kilogram cat was given doses of 250 and 500 mg. per kilogram body weight of α-ethyl-β-3,5-diiodo-4-hydroxyphenylpropionic acid intravenously without untoward reaction. More than 50 volunteers have taken oral doses of from 3 to 9 grams of the latter compound with remarkably little reaction. An occasional individual noticed a fleeting sensation of irritation on starting the urinary stream. Gastric distress and loose stools were insignificant, and true diarrhea has not been encountered. We have found doses from 3 to 5 grams completely adequate for clinical purposes.

The short chain compounds pass rapidly through the kidneys but slowly through the gallbladder. Because of this, good cystograms may be obtained in from six to eight hours by the oral route. The visualization of the gallbladder with these compounds is only fair. Kidney visualizations have been unsatisfactory as a rule with the compounds tested.

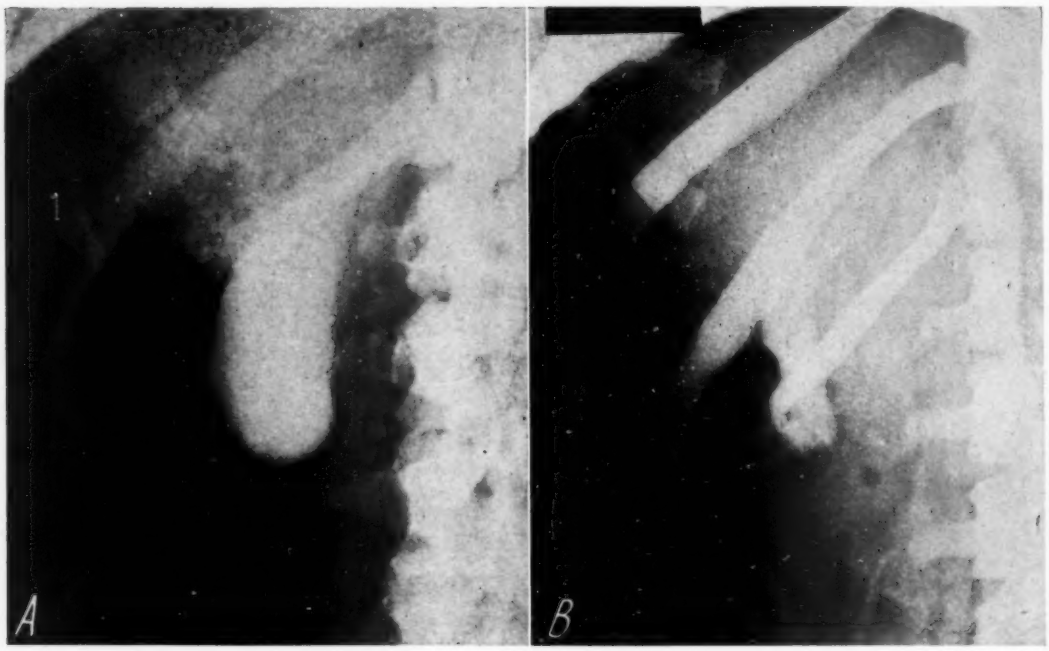


FIG. 6. *A*, roentgenogram of the right upper abdomen of an adult female volunteer twelve hours after the oral ingestion of 3 grams of alpha-ethyl beta (3-5-diiodo-4-hydroxyphenyl) propionic acid. The gallbladder is very well visualized. There were no systemic reactions. *B*, roentgenogram taken one hour after a prepared fatty meal (cholex). The gallbladder has contracted sharply.

The longer chain compounds, which are more oil soluble, are excreted principally from the liver into the gallbladder. Their later passage through the kidneys is demonstrated by the fact that good cystograms may occasionally be obtained together with oral cholecystograms. Oral cholecystograms which compare favorably with those obtained with reported compounds have been obtained consistently. At the present time we have narrowed the best compounds in the series to those containing saturated nuclei of from five to eight carbon atoms. These are sufficiently heavy to be extracted by the biliary tract, visualize the gallbladder and leave no trace of the opaque substance in the gastrointestinal tract. The longer carbon chains beyond the eight carbon nucleus likewise are excreted primarily through the biliary tract but may remain in small granules in the intestinal tract, resulting in small but disturbing

FIG. 7. Roentgenogram of the right upper abdomen of an adult female volunteer twelve hours after the oral administration of 3 grams of alpha-ethyl beta (3-5-diiodo-4-hydroxyphenyl) propionic acid. The gallbladder was very well visualized and there were no systemic reactions.

opacities from the roentgenographic viewpoint.

At the present time we have selected two compounds for more intensive clinical investigation. These are numbers 9 and 10 in Table 1, containing 57.0 per cent and 53.4 per cent iodine respectively. Thus far we have used these compounds in 50 volunteers in our laboratory and are satisfied that they are nontoxic and satisfactory for use in diagnostic procedures. Further investigation is in progress to test the various homologues in the series for their relative roentgenographic intensities in the study of the gallbladder and urinary tract.

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CAPSULES AND INSERTER FOR THE USE OF RADIUM CELLS IN THE TREATMENT OF CANCER OF THE UTERINE FUNDUS

By LLOYD A. CAMPBELL, M.D.
SAGINAW, MICHIGAN

THE use of a multiple capsule technique to increase the effectiveness of radium treatment in cancer of the fundus of the uterus is generally accepted by the profession. Although the number, size, shape and methods of application of the source may vary,[1,2,3,4,5] they all are based upon the use of many small, relatively weak capsules which are packed into the uterine cavity until it is filled.

To this treatment the standard platinum cell with its small size and relatively weak radium content can readily be adapted. Each capsule contains four cells giving a total filter equivalent to 1 millimeter of platinum. The capsules have an over-all length of 19 mm. and a diameter of 6 mm. The eye end of the capsule and the receptacle of the inserter are accurately machined at corresponding angles to fit together similar to a ground joint. This gives a rigidity to the capsule as it is tightly held by the inserter, thus making an easier and a more exact placement within the uterus.

FIG. 1. Inserter ready for use with a capsule in place and the wire loop over the retaining post.

The capsule is held by a wire stem consisting of four strands of No. 30 stainless steel wire tightly twisted together and looped at the proximal end to fit over a small retaining post on the plunger. The wire as thus made is stiff enough to retain the capsule where it was originally placed and the protruding wires aid in a better drainage of the uterine cavity. Replacement of new wires can be easily accomplished without special tools or skill. A Deknatel letter bead is threaded on the wire for identification as the capsules are best removed from the uterus in the reverse order of their placement. With the cervix sufficiently dilated at the time of introduction, no difficulty has been experienced in their removal if this procedure is followed.

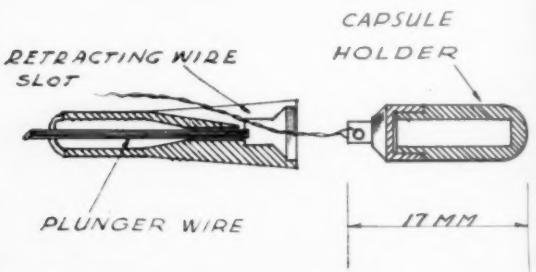

FIG. 2. Cross section drawing through the receptacle and capsule showing the corresponding surfaces which hold the capsule rigidly.

The inserter consists of the capsule receptacle as described, a hollow curved shank long enough for usual uterine work, and a handle of finger rests and plunger to which is attached a retaining post for the wire loop. The plunger extends the entire length of the instrument and is retracted constantly under tension supplied by a coil spring in the body of the handle. When the capsule is placed in the receptacle of the

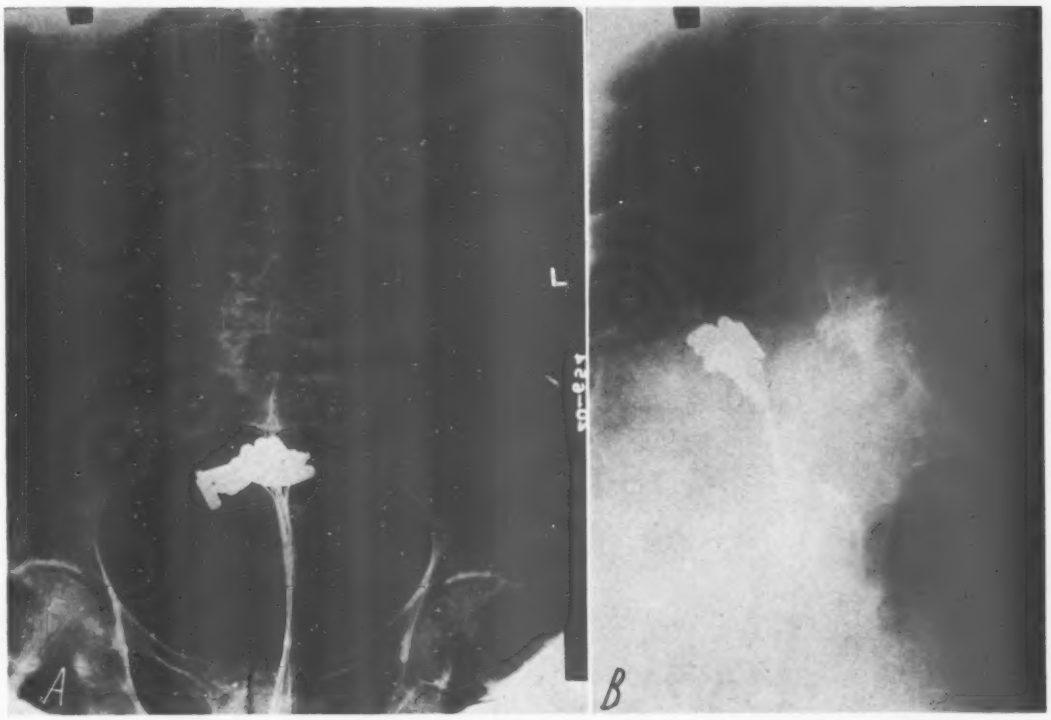

Fig. 3. Anteroposterior (*A*) and lateral (*B*) roentgenograms showing multiple sources of radium within a large uterus, with several capsules resting transversely against the fundus.

Fig. 4. Anteroposterior (*A*) and lateral (*B*) roentgenograms showing multiple sources of radium within a uterus of average size.

inserter and the wire loop over the retaining post, the spring tension holds the capsule firmly until released.

The instrument thus assembled is inserted into the uterus to the desired position, the plunger pressed about one-quarter of an inch to release the wire from the retaining post and then pressed a similar distance to dislodge the capsule from the receptacle. Two inserters speed the process as one can be loaded as quickly as the other is inserted and emptied. Approximately ten capsules will fill the average size uterus.

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Vol. 56, No. 2

IRRADIATION SICKNESS: HISTAMINE EFFECT TREATED WITH BENADRYL

A PRELIMINARY REPORT

By J. E. LOFSTROM, M.D., *and* C. E. NURNBERGER, PH.D.
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DETROIT, MICHIGAN

PATIENTS, ill with irradiation sickness as a result of deep roentgen therapy, are relieved of severe symptoms by administration of benadryl (beta-dimethylaminoethyl benzhydryl ether hydrochloride), a newly introduced antihistamine agent.* The degree and frequency of relief are so marked that it seems worth while to report preliminary results on a small series of cases.

The study of the present series of patients with irradiation sickness was initiated (1) because it was thought that a substance possessing antihistamine action, such as benadryl, might neutralize the activity of foreign proteins resulting from roentgen-ray disintegration of cells and thus be effective in controlling irradiation sickness and (2) because dramatic results were obtained when benadryl was administered in 2 cases of severe irradiation sickness. It was the latter which really precipitated our study, so it is worth while to consider them in detail.

CASE I. (Case 1, Table 1.) A female, aged forty, had undergone exploratory operation which revealed an inoperable papillary carcinoma of the ovary. She was referred for a course of deep roentgen therapy. After five treatments, irradiation had to be discontinued because of severe nausea, vomiting and diarrhea. A few days later she returned for further therapy. The following treatment plan was instituted: 250 kv., Thoraeus filter, 50 cm. skin target distance, and 200 r to each of two fields daily. Irradiation sickness promptly developed despite use of the usual prophylactic measures including increased fluid, carbohydrate, and vitamin intake. Her condition became progressively severe; she began to miss appointments and finally was bedridden three days before she was able to return for her seventh treatment. At that time she was given her usual daily dose of roentgen radiation and this was followed by intravenous injections of 10 cc. of benadryl (100 mg.). The immediate reaction to the injection simulated alcoholic intoxication. She became dizzy and drowsy, with unsteady gait, blurred vision, and slurred speech. The patient was kept in the clinic until intoxication subsided (three hours) and then sent home accompanied by a relative. She returned the following day, manifesting a most amazing change in condition. Nausea, vomiting and diarrhea had ceased; appetite and strength had returned. A change of personality occurred which was reflected by renewed interest in personal apearance and in her home. The patient was able to complete the roentgen treatment schedule without recurrence of irradiation sickness. While psychic elements may have played a rôle in her recovery from irradiation sickness, there were no reasons to suspect them, and thus, no attempt was made to exclude them.

CASE II. (Case 11, Table 1.) The second patient, an ambulatory female, aged forty-six, treated for a similar condition and by similar methods, developed extremely severe diarrhea, with marked anorexia, weakness and nausea. Intravenous injection of 10 cc. of benadryl (100 mg.) promptly stopped the diarrhea despite the fact that this patient had 25 stools during the preceding six hours. She likewise showed a striking improvement in morale which persisted throughout the balance of deep roentgen treatments.

METHODS AND PROCEDURES

Encouraged by these results we began routine use of benadryl in treatment of patients who developed definite symptoms of irradiation sickness. All other methods of therapy used previously for irradiation sickness were discontinued and the 19 cases reported in Table 1 are indicative of the

* Supplied for investigational purposes only by Parke, Davis and Company.

TABLE 1

SUMMARY OF CASES OF IRRADIATION SICKNESS TREATED WITH BENADRYL

Case	Diagnosis	Deep Roentgen Therapy; Region Treated; Dates	Date	Symptoms					Reaction
				Anorexia	Nausea	Vomiting	Weakness	Headache	
I	Carcinoma of ovary	Pelvis 1-29-46 to 2-14-46	2- 1-46	+++	+++	+++	+++	++	Diarrhea
			2- 6-46	+++	+++	+++	+++	++	
			2- 6-46	Benadryl intravenous 10 cc. 100 mg.					Sleepy, dizzy weak
			2- 7-46	+	o	o	+	o	Marked improvement; no diarrhea
			2- 8-46 2-14-16	+	o	o	+	o	
II	Carcinoma of ovary	Pelvis 1-29-46 to 2-25-46	2- 6-46	++	+	o	++	o	Severe diarrhea
			2- 7-46	++	+	o	++	o	
			2- 7-46	Benadryl intravenous 10 cc. 100 mg.					Vision hazy; walking unsteady; weak; drowsy
			2- 8-46	o	o	o	o	o	Marked improvement; no diarrhea
			2-18-46 2-23-46	+	+	+	o	+	
III	Recurrent carcinoma of breast, terminal stage	Breast; thoracic spine; neck 1-28-46 to 2-21-46	2- 8-46	++	++	o	++	++	
			2-13-46	++	++	o	++	o	
			2-14-46	++	++	o	++	o	
			2-15-46	Benadryl intravenous 10 cc. 100 mg.					Dizzy, sleepy, weak, apprehensive
			2-16-46	+	+	o	++	o	Improved
			2-19-46	+	+	o	++	o	
			2-20-46	+	o	o	++	o	
			2-21-46	+	o	o	++	o	
IV	Carcinoma of tongue	Tongue 2- 2-46 to 3- 6-46	2- 9-46	++	++	++	+	o	
			2-10-46	++	++	++	++	o	
			2-11-46	++	++	++	++	o	
			2-11-46	Benadryl 2 kapseals 50 mg. each					No reaction
			2-12-46	+	+	o	+	o	Improved
			2-12-46	Benadryl 4 kapseals 50 mg. each					No reaction
			2-14-46	+	+	o	+	++	
			2-16-46	++	++	o	++	++	To ill to come for treatment
			2-16-46	Benadryl intravenous 10 cc. 100 mg. at home					Weakness, sleepy, dizzy
			2-18-46	+	+	o	+	o	Improved; able to complete the series
			2-19-46 3- 6-46	+	+	o	+	o	

Case	Diagnosis	Deep Roentgen Therapy; Region Treated; Dates	Date	Symptoms					Reaction
				Anorexia	Nausea	Vomiting	Weakness	Headache	
V	Carcinoma of ovary	Pelvis 1-29-46 to 2-19-46	2- 9-46	++	++	+			
			2-10-46	+	o	+			
			2-11-46	+	++	++	++		
			2-12-46	Benadryl intravenous 10 cc. 100 mg.					Drowsy, weak
			2-13-46	o	o	o	o	o	Improved
			2-14-46	o	o	o	o	o	
			2-184-6	+	o	o	++	o	
			2-19-46	++	o	o	++	o	
VI	Carcinoma of breast	Breast 1-30-46 to 2-16-46	2-11-46	++	++	o			
			2-12-46	++	++	o			
			2-13-46	++	++	o			
			2-13-46	Benadryl 4 kapseals 50 mg. each					Drowsy
			2-14-46	o	o	o	o	o	Improved
			2-14-46	Benadryl 4 kapseals 50 mg. each					None
			2-15-46	o	o	o	o	o	
			2-16-46	o	o	o	o	o	
VII	Menopausal menorrhagia	Pelvis 2-11-46 to 2-21-46	2-12-46	++	++	o	o	o	
			2-12-46	Benadryl 3 kapseals 50 mg. each					No reaction
			2-13-46	++	+	o	o	o	
			2-14-46	++	+	o	o	o	
			2-14-46	Benadryl intravenous 5 cc. 50 mg.					Dizzy, weak
			2-15-46	++	o	o	o	o	Improved
			2-18-46	++	++	o	o	+	
			2-19-46	+	+	o	o	o	Improved
			2-20-46	o	o	o	o	o	
			2-21-46	o	o	o	o	o	
VIII	Lymphosarcoma	Cervical nodes; inguinal nodes; epigastrium 2-18-46 to 3- 4-46	2-18-46 2-27-46	+	o	o	o	o	
			3- 1-46	+	++	o	o	o	
			3- 1-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3- 2-46	+	o	o	o	o	Improved
			3- 4-46	o	o	o	++	o	

Case	Diagnosis	Deep Roentgen Therapy; Region Treated; Dates	Date	Symptoms					Reaction
				Anorexia	Nausea	Vomiting	Weakness	Headache	
IX	Carcinoma of breast	Breast and pelvis 2- 7-46 to 3- 1-46	2- 7-46 2-23-46	o	o	o	o	o	
			2-25-46	o	+	o	o	o	
			2-26-46	++	o	o	o	o	
			2-28-46	++	++	o	o	o	
			2-28-46	Benadryl 3 kapseals 50 mg. each					No reaction
			2-29-46	+	o	o	+	o	Improved
			3- 1-46	+	o	o	+	o	
X	Carcinoma of cervix	Pelvis 2-25-46 to 3- 7-46	2-26-46	o	o	o	o	o	
			2-27-46	o	o	o	o	o	
			2-28-46	o	+	o	o	o	
			3- 1-46 3- 2-46	o	o	o	o	o	
			3- 4-46	o	+	o	o	o	
			3- 5-46	+	+	o	+	o	Diarrhea
			3- 6-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3- 7-46	o	o	o	+	o	Improved; no diarrhea
XI	Carcinoma of cervix	Pelvis 2-26-46 to 3-15-46	2-26-46	o	o	o	++	o	
			2-27-46	+	o	o	++	o	
			2-28-46	+	+	+	++	o	
			2-28-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3- 1-46	++	+	o	++	o	No improvement
			3- 1-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3- 2-46	o	+	o	+	o	Improved
			3- 4-46	++	++	++	++	++	
			3- 4-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3- 5-46	+	+	o	o	+	Improved
			3- 5-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3- 6-46	++	+	o	+	+	No improvement
			3- 7-46	++	+	o	+	+	

Case	Diagnosis	Deep Roentgen Therapy; Region Treated; Dates	Date	Symptoms					Reaction
				Anorexia	Nausea	Vomiting	Weakness	Headache	
XII	Carcinoma of breast with bone metastases	Spine 3-11-46 to 3-18-45	3-13-46	++	++	++	++	+	
			3-14-46	Blood specimen at 11:50 A.M.					
				Benadryl intravenous 15 cc. 150 mg.					
				Blood specimen at 1:00 P.M.					
			3-18-46	++	++	++	++	+	No improvement
			3-18-46	Benadryl intravenous 10 cc. 100 mg.					Drowsy
				Benadryl 1 kapseal 50 mg.					
			3-19-46	+	+	+	++	+	
			3-19-46	Benadryl 2 kapseals 50 mg. each					No reaction
			3-20-46	+	o	o	+	o	Improved
			3-20-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3-21-46	o	o	o+	+	o	
			3-22-46	+	++	o	+	o	
			3-22-46	Benadryl 3 kapseals 50 mg. each					
			3-23-46	Benadryl 3 kapseals 50 mg. each					No reaction; improved
			3-24-46	Benadryl 3 kapseals 50 mg. each					
			3-25-46	o	o	o	+	o	
XIII	Carcinoma of tonsil	Tonsil 2-18-46 to 3-25-46	3-13-46	++	o	o	o	o	
			3-14-46	++	o	o	o	o	
			3-15-46	++	++	o	o	o	
			3-15-46	Benadryl 2 kapseals 50 mg. each					No reaction
			3-16-46	++	o	o	o	o	Improved
			3-16-46	Benadryl 1 kapseal 50 mg. each					No reaction
			3-18-46 3-25-46	+	o	o	o	o	Improved
XIV	Menorrhagia	Pelvis 3-11-46 to 3-14-46	3-11-46 3-12-46	o	o	o	++	o	
			3-13-46	++	++	+	++	+	
			3-14-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3-14-46	+	o	o	o	+	Improved
XV	Menorrhagia	Pelvis 3-20-46 to 3-22-46	3-21-46	o	+	o	o	+	
			3-22-46	+	++	o	o	++	
			3-22-46	Benadryl 2 kapseals 50 mg. each					No reaction
			3-23-46	++	++	++	o	++	No improvement
			3-23-46	Benadryl 1 kapseal 50 mg. each					Did not return

Case	Diagnosis	Deep Roentgen Therapy; Region Treated; Dates	Date	Symptoms					Reaction
				Anorexia	Nausea	Vomiting	Weakness	Headache	
XVI	Hodgkin's disease	Abdomen 3-21-46 to 3-26-46	3-22-46	o	++	o	o	+	
			3-22-46	Benadryl 2 kapseals 50 mg. each					No reaction
			3-23-46	+	++	++	o	+	
			3-23-46	Benadryl 3 kapseals 50 mg. each					No reaction
			3-24-46	Benadryl 3 kapseals 50 mg. each					
			3-25-46	o	+	o	o	o	Improved
XVII	Carcinoma of cervix	Pelvis 3-25-46 to 4- 6-46	3-26-46	o	+	o	+	o	
			3-27-46	o	+	o	+	o	
			3-27-46	Benadryl 2 kapseals 50 mg. each					No reaction
			3-28-36	o	o	o	o	o	Improved
			3-28-46	Benadryl 3 kapseals 50 mg. each					
			3-29-46	o	o	o	o	o	
			3-29-46	Benadryl 1 kapseal 50 mg. each					
XVIII*	Postoperative carcinoma of ovary	Pelvis 4-13-46 to 5- 1-46	4-15-46	++	++	++	++	o	
			4-16-46	++	++	++	++	o	
			4-16-46	Benadryl 2 kapseals 50 mg. each					No reaction
			4-17-46	+	+	o	+	o	Improved
			4-17-46	Benadryl 3 kapseals 50 mg.					No reaction
			4-18-46	o	o	o	o	o	
			4-18-46	Benadryl 1 kapseal 50 mg.					No reaction
			4-19-46 4-25-46	o	o	o	o	o	
XIX	Lymphoblastoma	Neck and axilla 4- 2-46 to 4-26-46	4-17-46	++	++	o	o	o	
			4-17-46	Benadryl 1 kapseal 50 mg.					No reaction
			4-18-46	+	+	o	o	o	Improved
			4-18-46	Benadryl 2 kapseals 50 mg.					No reaction
			4-19-46	+	o	o	o	o	
			4-20-46	o	o	o	o	o	

* Case XVIII had a second attack of irradiation sickness on April 29, 1946, with nausea, vomiting, anorexia and weakness. She was given 6 kapseals of benadryl, with instructions to take them one-half hour before each meal. She was much improved on April 30, and except for weakness, there were no more complaints. She finished her series May 1. This patient was a small, thin individual, and as was expected, developed diarrhea near the end of the therapy series. Benadryl did not relieve the diarrhea.

results obtained by means of benadryl therapy alone. Our omission of other supportive therapy for the condition does not imply that benadryl should be or must be used alone; on the contrary, measures such as increased fluid and vitamin intake can be continued with the benadryl. We used benadryl alone merely to evaluate the results more accurately. The chief complaints of these patients were anorexia, nausea, vomiting, weakness and headache. Since these symptoms appear consistently in

cases of irradiation sickness only the relief of these symptoms was used as an index of the efficacy of benadryl. The drug has not been employed as a prophylactic.

Both oral and intravenous administration of benadryl were tried. At first, the intravenous method was used; later benadryl by mouth gave relief and because of its simplicity and convenience, the oral method was used exclusively in the final 7 cases. The specific doses employed were arrived at by trial and error; and while they gave satisfactory results in most instances, better results may be forthcoming provided the quantity of benadryl and the time of absorption are evaluated more carefully.

For intravenous injections, 5 to 10 cc. (50 to 100 mg.) of benadryl was given. These patients experienced a side-reaction which appeared immediately after the injection and lasted one to four hours. They became dizzy, unsteady in motion, weak and drowsy. Later they developed a general feeling of wellbeing, as evidenced by renewed interest in themselves and in things about them, which lifted them from the depressed state so typical of cancer patients. Ambulatory patients unaccompanied by relatives were not permitted to leave until the drug intoxication had subsided. Hospitalized patients presented no particular difficulty.

Benadryl was given by mouth in the form of 50 milligram kapseals. From three to fourteen kapseals were given, one every four hours during the day; these patients experienced no marked reaction from the drug. It is our impression from observations on this small series of cases that benadryl by mouth will yield the desired amount of relief in most cases of irradiation sickness.

RESULTS

Eighteen of the cases summarized in Table 1 were improved by benadryl. The one exception, Case xv, disappeared from observation, and consequently the results of benadryl therapy are unknown. The degree of relief varied from patient to patient; in all but one instance (Case xiv), the patients felt well enough to continue their daily roentgen treatments without interruption.

After administration of fourteen kapseals of benadryl, marked symptoms of irradiation sickness persisted in Case xiv. He became too weak to come to the hospital so 10 cc. of benadryl (100 mg.) were given intravenously at his home. Two days later his condition had improved and he was able to come daily for roentgen treatments and to complete the series without further interruption. The difficulty of evaluating all of the factors having a rôle in production of irradiation sickness is well illustrated by this patient. He was treated for carcinoma of the tongue using two external fields, one on each side of the face, and one intraoral field. The lesion was only about 3 cm. in diameter and there was not extensive nor rapid destruction of malignant tissue with resultant absorption of toxic end products. We had a feeling that there was a very strong psychogenic factor as the chief cause of this patient's illness and hesitated to use benadryl. This patient represents the poorest response to treatment by this method.

DISCUSSION

The fundamental causes and mechanism of irradiation sickness are not known and therefore methods of treatment thus far proposed have met with little significant success, although irradiation sickness has harrassed radiologists since roentgen rays and radium were first utilized as therapeutic agents. The wide variety of etiologic factors elicited from review of the literature attests the lack of fundamental knowledge of the condition. Improvement in roentgenologic equipment has excluded such factors as static electricity and the inhalation of noxious gases such as ozone.[19] To correlate other alleged etiologic mechanisms of irradiation sickness and arrive at a single causative agent is perhaps impossible. Two main categories of phenomena become apparent in tabulating all of the suggested causes of this condition. First and most prominent are those causes directly attributed to metabolic disturbance. These include such reported factors as

changes in sodium, calcium and potassium metabolism,[1,13] disturbances in blood cholesterol[11], glycogen "dwindling,"[18] enzymatic stimulation,[7] choline poisoning,[14] the general debility and cachexia of the patient,[21] and the faulty absorption of certain vitamins.[9,15,23] Suggested therapeutic agents and procedures based on these etiologic theories have met with little acceptance although many radiologists routinely follow the suggested measures to improve fluid, carbohydrate and vitamin intake for lack of anything more efficacious.

The second general grouping relates to shock. A most comprehensive discussion of this mechanism is that by Jenkinson and Brown.[10] The theory of increased capillary permeability with its resultant influence on circulation producing the symptoms of irradiation sickness is supported by considerable experimental evidence. Their approach to therapeusis is directed to an intermediate point in the mechanism—the increased capillary permeability. This was accomplished by the use of amphetamine and d-desoxyephedrine.

The basis of this study and the theoretical explanation of results rests upon the contention that histamine-like bodies are developed in the blood of patients subjected to roentgen therapy and upon the hypothesis that benadryl by virtue of its antihistamine action, neutralizes these H-substances.

That active histamine-like substances are developed, or increased, in the blood is substantiated by extensive experimental studies both in animals and in man. Best and his co-workers[2] found histamine-like bodies, consisting partly of histamine itself, in certain tissue extracts. These bodies are present in tissues, and when tissues are irradiated, the H-substances are liberated from the cells and thus may enter the blood. Cramer[5] has detected them in fresh blood samples. Beutel and Klein[3] studied various effects of H-substances in circulating blood and found them among an increased capillary permeability. Michaelis[16] showed a capillary dilatation remote from the area of roentgen exposure. Pansdorf and Nell[17] believe that dilatation of capillaries accounts for the fall in blood pressure following roentgen therapy.

The theory of histamine-like bodies in the circulation is supported further by the formation of gastric ulcers following intensive irradiation. Histamine, which cause hypersecretion and hypermotility of the stomach, has actually produced ulcers in the stomach of guinea pigs.[4] More recently Forfota and Karaday[8] have found other signs of the presence of H-substances in the circulation. Changes in blood pH and associated changes in blood mineral levels can be ascribed to these substances. Thus the H-substances are demonstrated to have an important rôle in the systemic effects of roentgen therapy.

The use of benadryl in the treatment of a variety of known allergic diseases has been widely reported. Curtis and Owens[6] found that patients suffering from urticaria experienced prompt relief of symptoms as long as benadryl was taken. Other observations on benadryl as an antihistamine agent have been reported by Wells, Morris, Bull and Dragstedt[21], by Shaffer, Carrick and Zackheim[20] and by McElin and Horton.[12] The rationale of all of this work has been the suppression of the histamine factor.

Determinations of blood histamine on these patients were desirable; this was possible in only one instance. Samples of blood were taken from this patient after moderately severe symptoms of irradiation sickness had developed. The histamine level was so high that errors of determination were suspected; but we were unable to check it. This, however, has provided an impetus to further study and experiments; tests are now in progress on both patients and animals.

CONCLUSIONS

1. Irradiation sickness is a condition manifesting many of the characteristics of histamine toxicity.

2. It is postulated that histamine may be produced as a result of aberrations in cel-

lular metabolism and tissue destruction following radiation therapy.

3. The use of benadryl as an antihistaminic substance in the treatment of irradiation sickness is efficacious in a high percentage of cases. Intravenous use of the drug is followed by the most dramatic response, good clinical results are also obtained from oral administration of benadryl.

4. On the basis of successful relief of symptoms by benadryl therapy of allergic diseases and in irradiation sickness, and on the basis of benadryl's antihistaminic action in both groups of diseases, it is suggested that irradiation sickness may be an allergic phenomenon.

5. The cerebral depression so common in patients suffering from malignant disease and often accentuated during radiation therapy may be a toxic manifestation of elevated blood histamine. Marked improvement in the mental condition of patients in this series supports this hypothesis.

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SOME HISTORICAL DATA RELATING TO THE DISCOVERY OF THE ROENTGEN RAYS

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RECENTLY it has been my privilege to make several postwar visits to Würzburg[1] to carry out some investigations bearing on the discovery of the x-rays, which was made just fifty years ago in November, 1895, by Wilhelm Conrad Röntgen. The present director of the Physical Institute and Professor of Physics, Dr. Friedrich Harms, and his assistants[2] have been very helpful and willing to add any information they could to the story of Röntgen already so well told by Glasser.[3] One would think, after all these years, that little more would be left to be said, but it appears that in the time just preceding and during the war years (1933–45), there has been considerable controversy, with the help of the Nazi press and some party members, over the position of Röntgen in the annals of science.

Articles appeared in the daily papers in such organs as *Völkischer Beobachter, Das Schwarze Korps* and others suggesting that Röntgen had done nothing remarkable, but merely had carried to its inevitable conclusion, a bit precociously perhaps, the work of the great Aryan Scientist, Philipp Lenard† (Fig. 1). Director of the Physical Institute at Heidelberg University.‡ To the students at Würzburg these stories seemed a bit at variance with what Dr. Harms had been teaching them of Röntgen's discovery, so to clarify the history and answer their questions additional information was brought to light. Prof. Johannes Stark, as they all knew, was President of Hitler's Physical and Technical Reichsinstitute in Berlin and, with Lenard, was a top ranking Nazi scientist. In an article[4] eulogizing Stark on his seventieth birthday, Lenard tells of Stark's researches when, as successor to Röntgen as director of the Physical Institute at Würzburg (1920–1921), he refers to the "dark history" of the burning of Röntgen's notes concerning his discovery and implies that there was something hidden from view. Earlier (1935) Stark had had written a paper[5] minimizing the rôle of Röntgen in the discovery of the rays which bear his name, and attributed the discovery to the coincidence of three accidental circumstances of which more will be said later. In the same edition of the periodical, F. Schmidt,[6] Assistant Professor of Physics at the Reichsinstitute in Berlin, proved to his own satisfaction that Lenard had indeed already made notes of x-ray effects when experimenting with his cathode-ray tube, but as sagely observed by Max Wien,[7] the Assistant of Röntgen 1893–1895, "He did not investigate these effects and he did not publish anything about them. Under other conditions, more favorable, Lenard perhaps could have observed stronger effects, and then he would have been the discoverer of X-rays—." So it was during the years of the Nazi ascendency that Lenard, Stark, Schmidt and others engaged in a mutual admiration society, and in the case of Lenard, at the expense of the fame of Röntgen.

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† Zehn Kameraden, Philipp Lenard, der Deutsche Naturforscher, Sein Kampf um nordische Forschung. J. F. Lehmanns Verlag, München, 1937.

‡ "The Philipp Leonard Institute."

[4] Lenard, P. Johannes Stark zum Geburtstag, April 15. *Völkischer Beobachter*, No. 106, April 14, 1944.

[5] Stark, J. Zur Geschichte der Entdeckung der Röntgenstrahlen. *Phys. Ztschr.*, 1935, *36*, 280–283.

[6] Schmidt, F. Über die von einer Lenard-Fensterröhre mit Platinansatz ausgehenden Röntgenstrahlen. *Phys. Ztschr.*, 1935, *36*, 283–288.

[7] Wien, Max. Zur Geschichte der Entdeckung der Röntgenstrahlen. *Phys. Ztschr.*, 1935, *36*, 536.

As remarked by Glasser[8] in his newly published book the attitude of Lenard about Röntgen has seemed enigmatical. Bringing a great deal of light to this subject are some letters between Lenard and Röntgen preserved in a safe at the Physical Institute at Würzburg, written statements by Lenard in his most recently published work[9] and direct statements made to me on the occasions of two interviews with Lenard. The letters, of which several photostatic copies were made and sent to a few German scientists for safe keeping during the war, have not been made public until this time. The Physics Department feared the Nazis would get hold of the originals and destroy them as the only incontrovertible evidence existing of the true facts in the controversy of Lenard vs. Röntgen. Röntgen must have sensed that some day there would be a need of these letters or else he would have had them destroyed, as directed in his will, with the other papers concerning his work. On the envelope enclosing the correspondence Röntgen had written, "Letters from P. Lenard—of some interest in the judgment of the writer." These are the letters spoken of in Röntgen's letter to Zehnder[10] where he says, "I was astonished while going over my old letters to find some written by Lenard that show a friendly attitude toward me, which however, stopped completely about the time Wien succeeded me in Würzburg and I received the Nobel Prize." Indeed these letters do show a friendly attitude even in the first one from Bonn (Fig. 2) where Lenard responded to Röntgen's request for information about the source of aluminum windows for the tube by sending him two of the scarce items from his own store. The letter from Röntgen (Fig. 3) disclaiming any knowledge of, or responsibility for, the unkind remarks of Zehnder, was answered by a very informative one from Lenard (Fig. 4)

Fig. 1. Photograph of P. Lenard on his eightieth birthday, 1942. Translation of note on back: "Dr. Etter, the representative of the conqueror, with thanks for his scientific interest. Messelhausen, 20 Sept. 45. P. Lenard"

in which he makes the extremely revealing statements, "Because your great discovery caused such remarkable attention in the farthest circles my modest work also has come into the limelight, which was of particular luck for me, and I am doubly glad to have had your friendly participation—especially through the presence of the ray discovered by you—." Even the last letter of the group (Fig. 5) shows a continued amiable spirit with a request from the young scientist Lenard for an assistant trained by the older man.

What then changed the attitude of Lenard from that shown above to his openly antagonistic attitude toward Röntgen and his discovery? It will be seen from the foregoing letter to Zehnder[10] that Röntgen attributed the change to his receipt of the Nobel Prize and, for all we know, that may have been the beginning.

[8] Glasser, Otto. Dr. W. C. Röntgen. Charles C Thomas, Springfield, Illinois, 1945.

[9] Lenard, P. Wissenschaftliche Abhandlungen. Band III. S. Hirzel, Leipzig, 1944.

[10] Zehnder, Dr. Ludwig. W. C. Röntgen. Briefe an L. Zehnder. Rascher & Cie, Zürich, 1935.

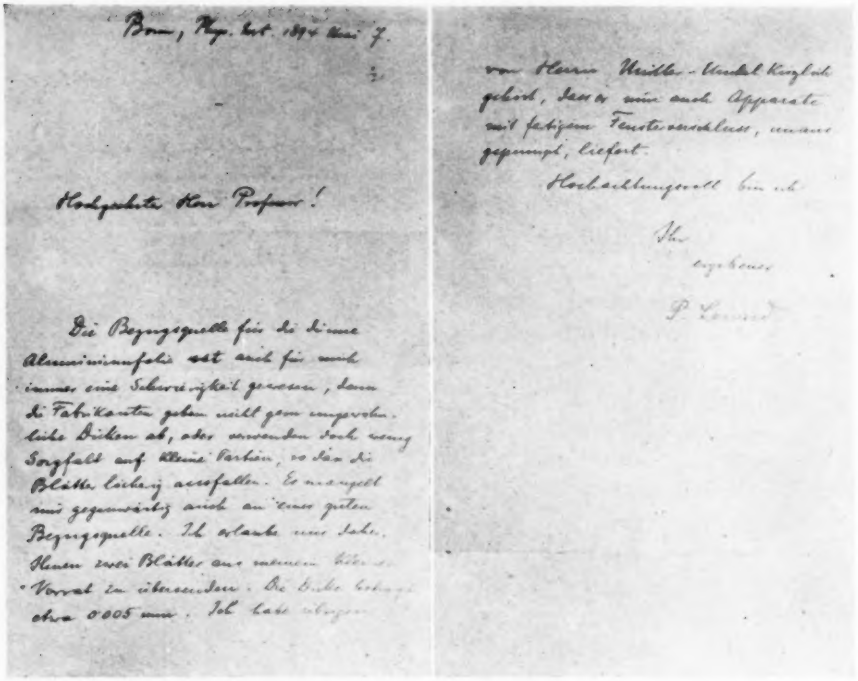

FIG. 2. Letter from Lenard to Röntgen, Bonn, May 7, 1894 (with translation).

Bonn, Phys. Inst., 7 May '94

HIGHLY ESTEEMED PROFESSOR:

The source for thin Aluminum sheets presents great difficulties for me too, since the manufacturers hesitate to give up unusual sizes (thicknesses) or they take little care with small parts, so that the sheets turn out full of holes. I too am lacking a good source of Al. I permit myself to send you two sheets from my supply. The thickness is about 0.005 mm. By the way I have heard lately from Mr. Müller-Unckel that he is manufacturing apparatus with a complete window and not evacuated.

With high esteem I am
Your obedient,

P. LENARD

Certainly a deprecating estimate of Röntgen's rôle in the discovery of the x-rays was given by Lenard in his own Nobel Prize Lecture in 1905[11] when he says, "In this tube (of mine) the intensified cathode rays meet on the large surface of the platinum, that metal which we all know now transforms them—as wasn't known at that time—into Röntgen's rays. . . . However, given this tube, the attention of the observer, already diverted from the inside to the outside . . . it seems to me that the discovery at this stage of the development appears to follow automatically." Along the same line Lenard is reported to have said at about this time "that anyone who was wideawake and using a Lenard tube could have discovered the x-rays." The obvious question then is, "Why didn't Lenard discover them?" His answer is fourfold.[12,13] First, he was engaged at the time in moving

[11] Lenard, P. Wissenschaftliche Abhandlungen. Band III. S. Hirzel, Leipzig, 1944, footnote, p. 5.

[12] Lenard, P. Wissenschaftliche Abhandlungen. Vol. III. S. Hirzel, Leipzig, 1944.

[13] Freund, F. Lenard's share in the discovery of x-rays. *Brit. J. Radiol.*, March, 1946, *19*. In this paper the author draws attention to the fact that Lenard noted fluorescent and photographic effects of cathode rays up to a distance of 8 cm. and failed to explain discharge of an electroscope up to 30 cm. Also he notes that while Lenard demonstrated the range of cathode rays in air to be only 8 cm., he did not explain the photographic effect he observed to have taken place through a sheet of cardboard. When Lenard missed the explanation of these seeming paradoxes he missed the discovery of x-rays.

from Bonn to Breslau and this upset his research. Second, he had encased his tube with a tin jacket to exclude the intrinsic light of the tube from the darkened room, better to observe fluorescence on the screen held before the aluminum window of the tube. Third, he had not used barium platinocyanide among the fluorescent substances tried because he did not have ready access to a supply of it that was in the hands of his superior, Prof. Hertz, but used instead pentadecylparatolylketon (keton). Hertz kept the keys* and young Lenard was not permitted to use anything he had a mind to use. In the fourth place Lenard states that he himself received an imperfect tube from the glassblower, Müller-Unckel, while Röntgen received one of the first tubes made perfectly. The last three of these circumstances are those given by Stark[5] in his above mentioned paper as the accidental happenings bringing Röntgen the honor of the startling discovery. But it may well be questioned whether indeed all these happenings were simply accidental. That will be discussed later.

Meanwhile, permit me to give more in detail Lenard's personally stated position as of the present day. Having fled from Heidelberg on the near approach of our armies to a tiny village in Bavaria† Lenard sits today in his house ready to state his position clearly on his view of Röntgen. At the time of my first interview with him, September 6, 1945, he referred me for amplification of his remarks to his new four volume work published in part in Munich, of which three volumes are now off the presses.[12] The fourth has not yet been published as the printing plant was destroyed by bombing this year (1945). I obtained Volume III from his present doctor in a nearby village‡ and was surprised to find a note written and signed by P. Lenard on the fly-leaf saying, "To be found in this volume: My reckoning with Röntgen, held back for almost fifty years: p 65/66, 1 and 5, 69, 177/178. Again I speak now only because of my ineradicable desire for truth. For fifty long years one was so dull never to care seriously about the actual coming about of a rather much noticed and practically used discovery."

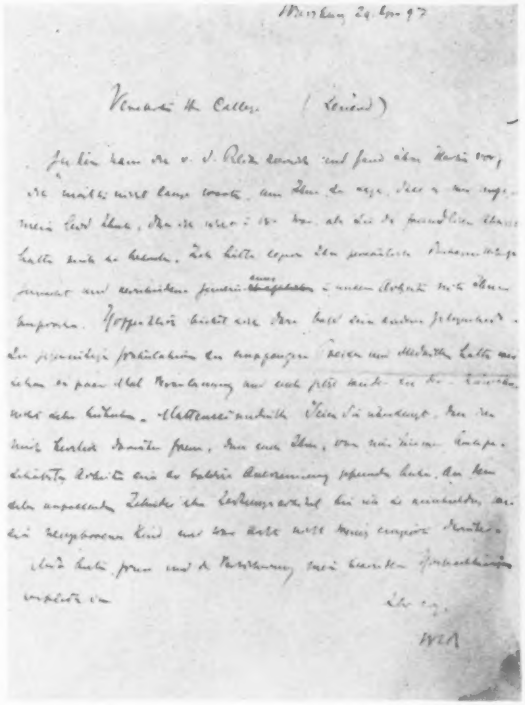

Fig. 3. Röntgen's letter to Lenard April 24, 1897 (with translation). This is a copy made by Röntgen of the letter he sent to Lenard. When queried about the friendly tone of this letter Lenard called it a "Katzenbrief."

Würzburg, 24 April 1897

Esteemed Colleague (Lenard):

Today I came back from travels and found your card. I won't hesitate longer to tell you how sorry I am I wasn't in Würzburg when you had the friendly intention to visit me. I would have liked to make your personal acquaintance to discuss with you various works of common interest. I hope there will soon be another opportunity to do so. For the receipt of prizes and medals we several times have had reason for mutual congratulations, and now again for the series of reprints in large numbers—not of great artistic value. Be assured that I am very happy that my work has found such a ready recognition from you. As to the untimely newspaper articles by Zehnder I am as innocent as a newborn child and was furious about it. With best regards and assertion of my highest esteem I remain yours,

W.C.R.

* Personal interview, September 20, 1945.

† Messelhausen.

‡ Dr. Emil Härtig, Grunsfeld, Bavaria.

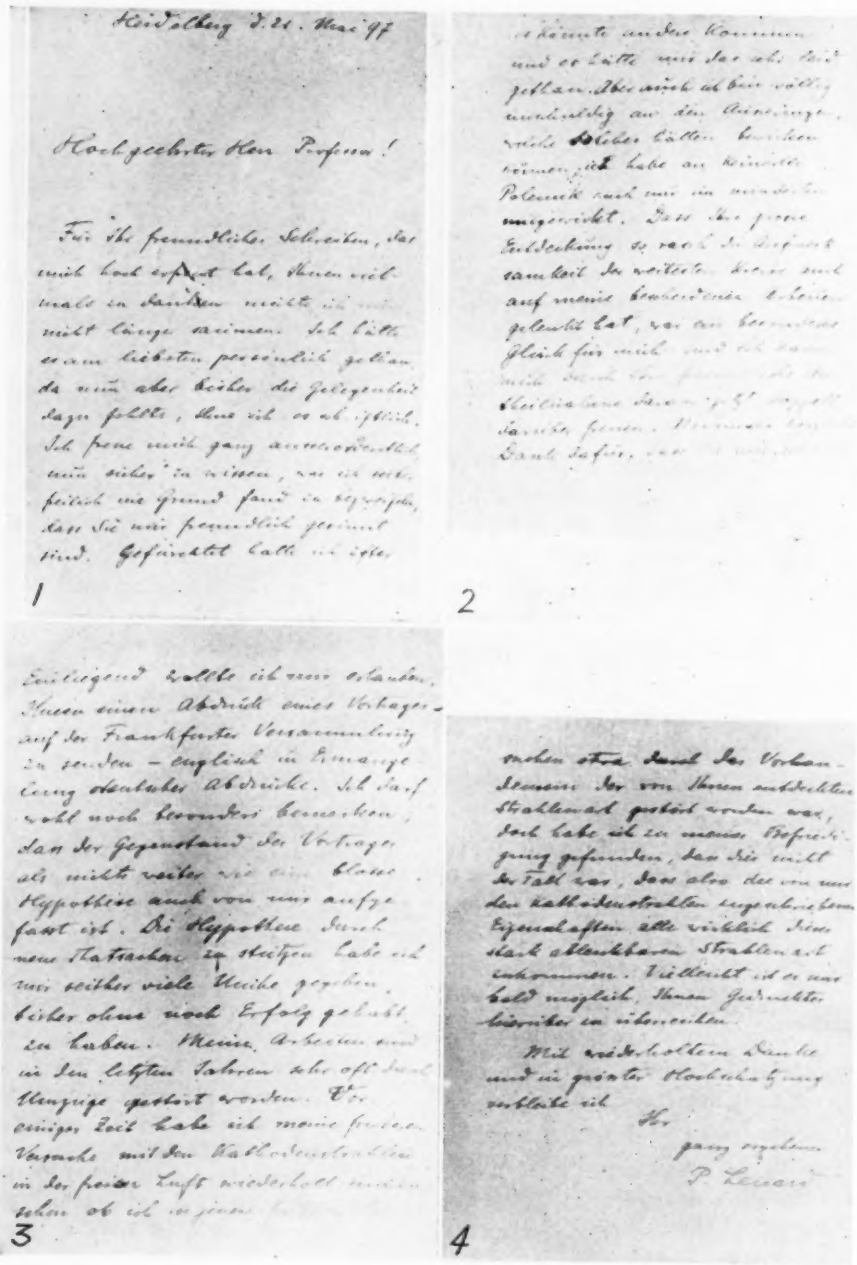

FIG. 4. Lenard's letter to Röntgen (with translation).

Heidelberg, 21 May '97

HIGHLY ESTEEMED PROFESSOR:

For your kind letter that I was happy to receive, I thank you many times. I had preferred to have done it personally but as I had no opportunity so far I'm writing to you. I was particularly happy to know for sure, what I had never any reason to doubt, that you are friendly toward me. I was often afraid it could have been otherwise and I would have been sorry for that. However, I am completely innocent of any remarks which could have caused this to be. I never took part in any of the slightest Polemics. *Because your great discovery caused such swift attention in the farthest circles my modest work also came into the limelight, which was of particular luck for me, and I am doubly glad to have had your friendly participation.* Again many thanks that you wrote to me. Enclosed permit me to send you a copy of a lecture to the Frankfurt Congress (in English since

"Discovery of electrons: p 1, 35, 73, 81, 197. Unlocking the atomic nucleus, p. 237/238, 250. Concerning a few Jews (Warburg, Rubens) and their rôle in Germany, p. 339, 297."

Upon reading the detailed references given one can very definitely understand Lenard's view of the discovery. It is given in part in no uncertain terms in a footnote on page 178, thus: "A comparison can best make clear to the neutral observer Röntgen's rôle in the discovery. I shall make this striking comparison here because it may throw a light on the even now widespread historical confusion and untruth! Röntgen was the midwife at the birth of the discovery. This helper had the good fortune to be able to present the child first. She can only be confused with the mother by the uninformed who knows as little about the procedure of the discovery and the preceding facts as children of the stork."

On the occasion of our second interview* he gave a slight variation of his view to be quoted thus, "I am the mother of the x-rays. Just as a midwife is not responsible for the mechanism of birth, so was Röntgen not responsible for the discovery of x-rays, which merely fell into his lap. All Röntgen had to do was push a button, since all the ground work had been prepared by me."** Further, he stated for quotation, "Without my help the discovery of x-rays would not have been possible even today. Without me the name of Röntgen would be unknown. Röntgen was an opportunist who sensed there was something to be found in experimenting with my tube which he carried out with an eye to fame... Hittorf developed the discharge tube first in 1869, and a little was added to it by Crookes in 1879. But nothing of great importance was added to it until my work twenty-five years later. I was always *too modest* and did not rush into print. In my letter to Röntgen (Fig. 4) where I praised him for his great discovery I thought he would reply that he really owed it all to me and my tube, but I waited for this acknowledgment from him in vain." Here† then is given the answer to the puzzle of Lenard's long smoldering antagonism to Röntgen.

Among the letters from Lenard preserved by Röntgen in the safe at Würzburg is also one from the chemist Krafft (Fig. 6) of Heidelberg, July 7, 1894, telling of his sending a supply of pentadecylparatolylketon (keton) to Röntgen. This gives the clue to Röntgen's use of barium platinocyanide. He knew this substance had slight fluorescent properties in ultraviolet light, and since he did not have any keton on hand at the time he received his Lenard tube (May, 1894) and wished to repeat Lenard's then recently reported experiments,[14] he rea-

* September 20, 1945, also at Messelhausen.

** Lenard, P. Wissenschaftliche Abhandlungen, Vol. III—footnote p. 65—"the discovery must have been easy if not unavoidable for the head of a Phys. Inst. who had all the necessary equipment ready at hand."

† Lenard, P. Wissenschaftliche Abhandlungen. Vol. III. Footnote p. 65. "However I thought for sure that Röntgen himself would express himself even more satisfactorily as to the origin of his discovery than he actually did . . . He even ordered the unseen burning of his manuscripts (1921) pointed out by him which originated from the period of the discovery and which was duly executed . . . . Clearly understandable, I made it already in 1906 in a comment (Nobel Speech No. 10, Sec. 8) which Röntgen never disputed in these 17 remaining years of his life . . . ."

[14] Lenard, Philipp. Ueber Kathodenstrahlen in Gasen von atmosphärischem Druck und im äussersten Vacuum. *Ann. d. Phys.*, Jan., 1894, *51*, 225.

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not enough German copies are to be had). May I particularly point out that the subject of the discussion is nothing more than a weak hypothesis in my opinion. In the meantime, I have tried hard to establish new proofs of that hypothesis, though so far I've had no success. My work has been disturbed several times during the last year due to my moving. A short while ago I had repeated my former experiments with the cathode rays in the open air to find out whether my former experiments have been disturbed, *especially through the presence of the rays discovered by you*, However, I have found to my own satisfaction that this is not the case, but that the properties I gave my cathode rays apply really to these divertible rays. Perhaps it is possible for me very soon to present you with some printed matter on this subject.

Again I thank you with greatest respect, I remain sir,

Yours truly,

P. Lenard

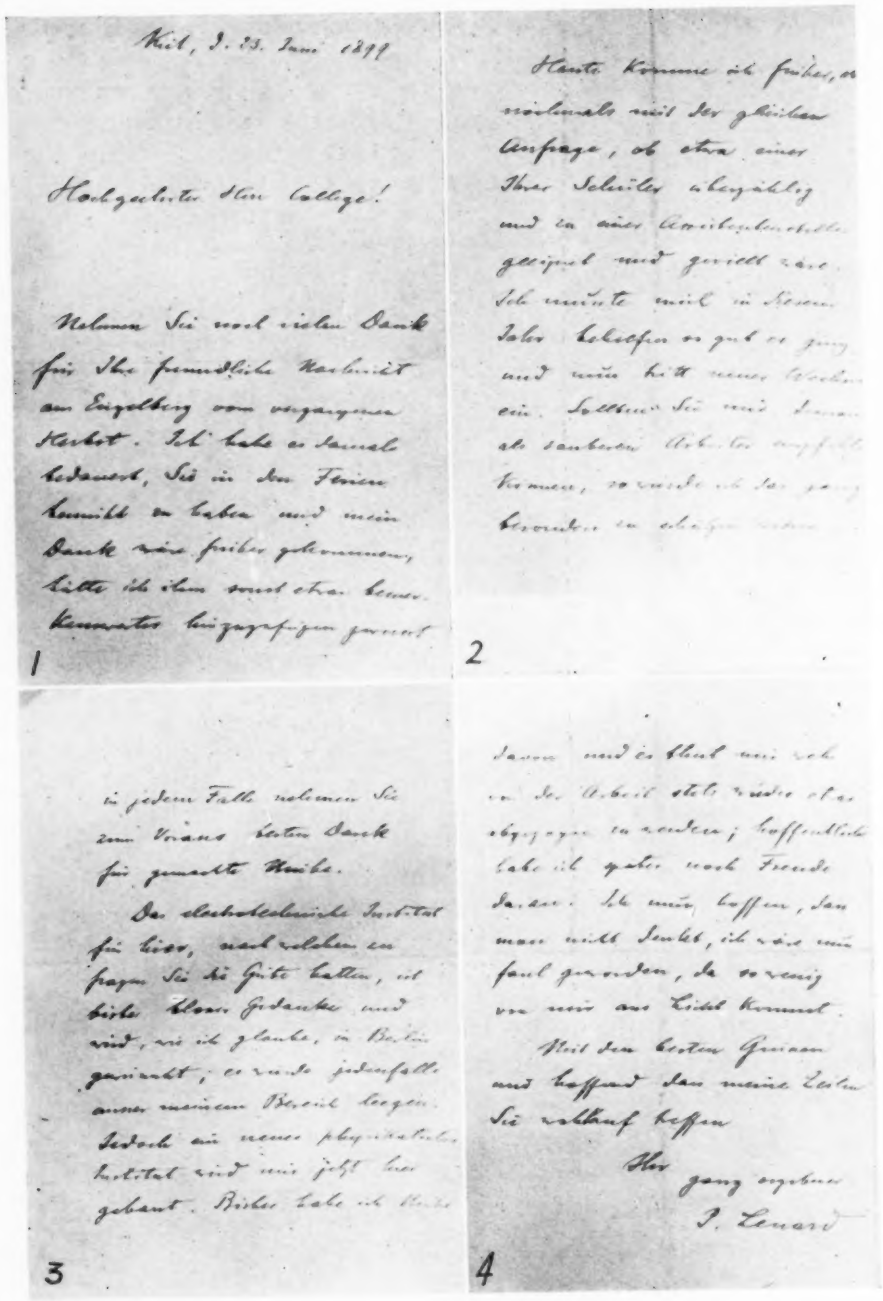


Fig. 5. Letter from Lenard to Röntgen, Kiel, June 23, 1899 (with translation)

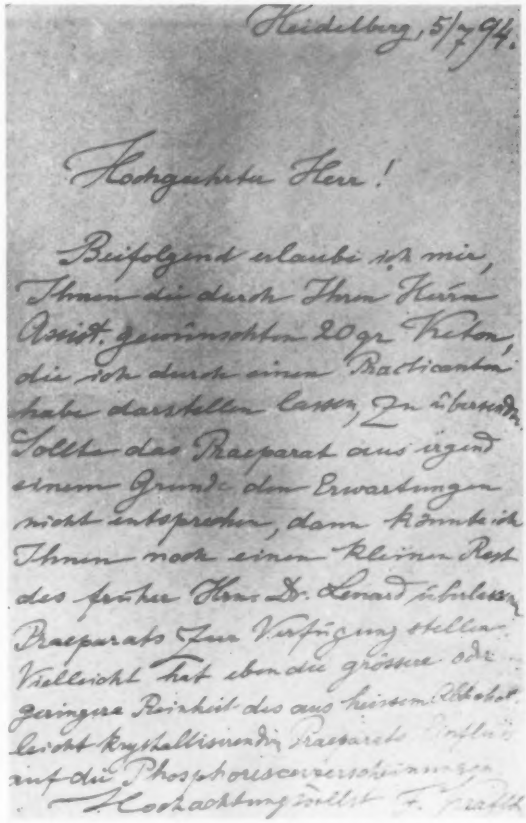
Kiel, the 23 June 1899

Highly Esteemed Colleague:

Accept again my best thanks for your kindly notification from Engelberg last fall. I was sorry then to have troubled you on your vacation and my thanks would have come earlier had I been able to add something better.

Today I come earlier but again with the same request, whether one of your students would be available and able and willing to accept a position as assistant. I had to help myself this year as well as I could and now

soned, as any scientist might have done, that barium platinocyanide could serve as a substitute. So he set up Lenard's apparatus with the tin box enclosure, as described in his paper, and found that the screen made with a coating of barium platinocyanide fluoresced very well at the window of the Lenard tube, as he thought from the presence of cathode rays. Then, with the probity of genius, he tried this screen in proximity to his Hittorf tube and again noted fluorescence. Thinking he might be deceived by the intrinsic light of the tube he placed some black cardboard around it and tried the experiment again. When he still had fluorescence he could have concluded that barium platinocyanide was exceptionally good for demonstrating even very weak cathode rays that may after all have come through the glass and black paper. For, had he not seen the same fluorescence of the screen at the window of the Lenard tube where he had good reason to expect many cathode rays, as he now saw in the vicinity of the Hittorf tube? This was in May, 1894. In July he received the keton from Krafft, the partly emptied original vial of which is still in the laboratory at Würzburg. It is not known whether he continued his experiments then with cathode rays or waited until late summer or fall of 1895. But when he compared the effects of the tubes (Hittorf's, Lenard's, Crookes') on keton* and on barium platinocyanide screens he knew he was dealing with a new kind of ray and this was not merely accidental. Repeating the experiments, he found not even a faint effect on keton from


Heidelberg, 5/7 94.

Hochgeehrter Herr!

Beifolgend erlaube ich mir, Ihnen die durch Ihren Herrn Assist. gewünschten 20 gr. Keton, die ich durch einen Bacteriantem habe darstellen lassen, zu übersenden. Sollte das Praeparat aus irgend einem Grund den Erwartungen nicht entsprechen, dann könnte ich Ihnen noch einen kleinen Rest des früher Herr Dr. Lenard überlassenen Praeparats zur Verfügung stellen. Vielleicht hat eben die grössere oder geringere Reinheit des aus heissem Alkohol leicht krystallisirenden Praeparats Einfluss auf die Phosphorescenzerscheinungen.

Hochachtungsvollst F. Krafft

Fig. 6. Krafft's letter to Röntgen (with translation).

Heidelberg, 5 July '94

Highly Esteemed Sir:

Enclosed I take the liberty of sending you through your assistants, 20 gr. of keton which you desired. Should this preparation for any reason not meet your expectations, then I could let you have the remainder of what was prepared for Dr. Lenard. Possibly because of the higher or lower purity of the preparation made from hot alcohol and being easier crystallized, it had some effect on the appearance of the fluorescence.

With great respect,
F. Krafft

* A keton screen is made simply by melting a few crystals of the substance on a piece of paper with a little heat.

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a new change has come. Should you be able to suggest a clean worker, then I would appreciate it very much. In any case, accept my best thanks beforehand for your trouble.

The Electrotechnic Institute here, which you kindly inquired about, is so far a mere idea, and I think is only a wish from Berlin. Anyway, it would be outside my activities. However, a new Physical Institute is being built here for me. So far I have troubles with it and it hurts me to be drawn away again and again from my work. I hope to have a good deal of pleasure in it someday. I hope that people won't think I have grown lazy since so little comes to light from me.

With best regards and hopes that this finds you in best health, I am always your very obedient

P. Lenard

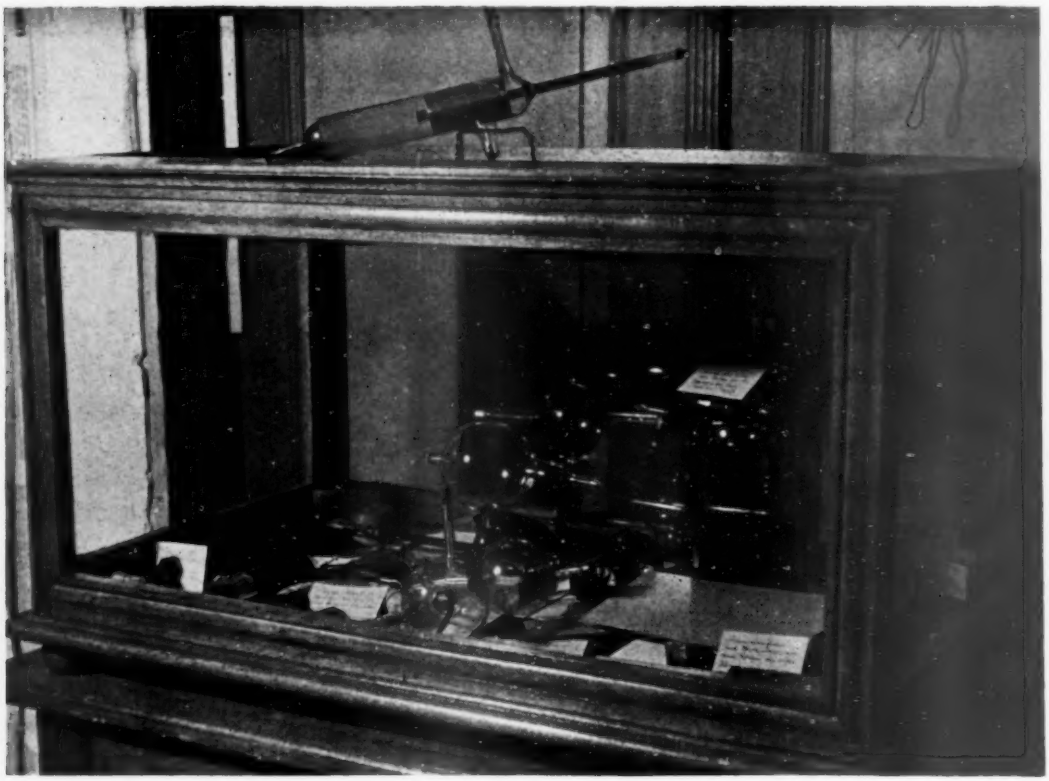

Fig. 7. The cabinet in Röntgen's library in the Physical Institute, University of Würzburg, containing the historical collection. Original and only Lenard tube with which he experimented is shown outside the case, so placed by the Physics Faculty as symbolic of the fact that it was not essential in Röntgen's discovery.

the Hittorf tube incased in black carton, but good fluorescence with the barium platinocyanide. He even raised the tension on the order of 15 to 20 kv. trying to force the cathode rays through the glass walls,* but still no effect on the keton screen was observed. He noted the same effects with the Crookes tube. Then, substituting black carton paper for the tin box surrounding the Lenard tube, he found fluorescence of the keton screen only at the window and in no other position around the tube. But with the barium platinocyanide screen there was good fluorescence in all positions. It now became clear to Röntgen that cathode rays were completely absorbed by the glass walls of the Hittorf and Crookes tubes and could get out of the Lenard tube only through the aluminum window; further, that the keton screen fluoresced only in presence of cathode rays and not in the rays that passed through the black carton. And he now knew why he had earlier obtained fluorescence with his barium platinocyanide screen in proximity to the Hittorf and Crookes tubes: all the activated tubes generated a new but powerful unknown ray that penetrated the glass walls and even thick black paper! Was this great discovery then merely accidental, or the climax of scientific research guided by the light of genius? The reader must be the judge.

Lenard claims that his tube and no others was responsible for the discovery,† and this because the platinum cylinder insert was such a good source of x-rays.[15]

* Röntgen was on the right track, since with sufficiently high kilovoltage (1,000 kv.) it is possible to force cathode rays through the glass, as is now known.

† Personal interview, September 20, 1945.

[15] Lenard, P. Wissenschaftliche Abhandlungen, Band III,

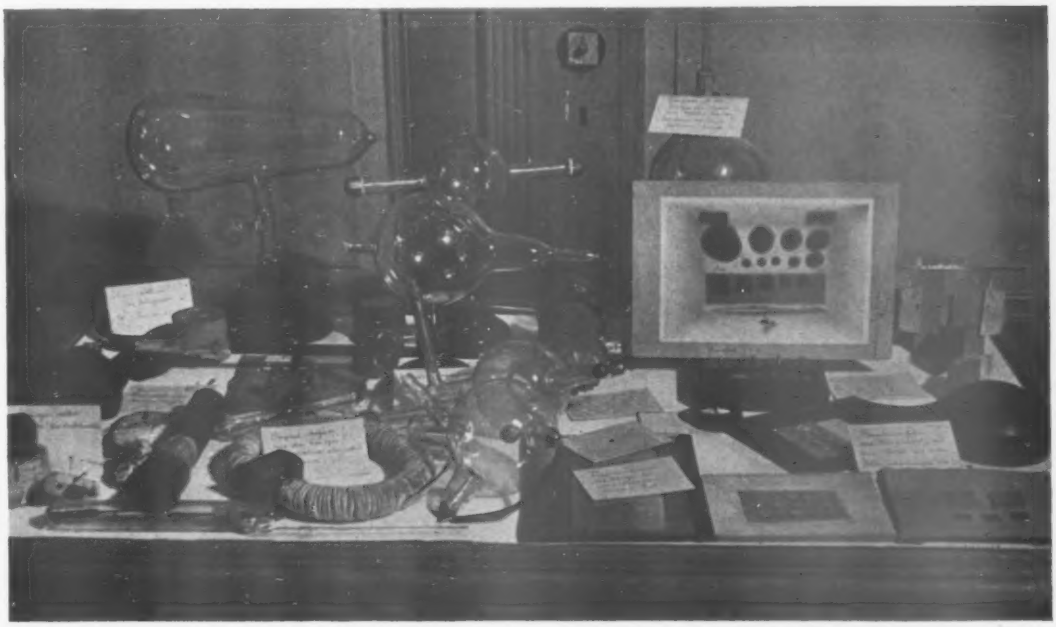

Fig. 8. Here shown are Crookes tube, left background, several Hittorf tubes in center, glass jar for ionization of air with print of box of weights standing against it; prisms along right edge with masks of lead and aluminum in right foreground. In left foreground at very edge an "absolute evacuated" tube (Röntgen used many of these) with electromagnet beside it.

However, the Würzburg Physical Institute's laboratory order book shows that only one Lenard tube was ever ordered (Fig. 7), but that beginning in September, 1895, many of the tubes called in the trade by Müller-Unckel "absolute evacuated" were ordered by Röntgen and used in his further study of the physical properties of x-rays (Fig. 8). Röntgen did not stress the use of platinum as a means of transforming cathode rays to x-rays, but rather tried to get higher vacuum and to use higher kilovoltages (25–30 kv.) to secure more penetrating rays. This he was able to do with the "absolute evacuated" tubes. Röntgen freely stated that he used Lenard's tube and repeated his cathode-ray experiments, but did not ever say he used it to the exclusion of other types of tubes.* In his "Ueber

footnote p. 69. "It must have been known to Röntgen during his discovery attempts that platinum is especially effective in the production of the new rays, much more effective than glass on which the cathode rays fall in the common discharge tube. The tube with which he made his discovery was the one with a platinum insert (see below also footnote p. 5) but he also used a Crookes focus tube in which cathode rays also hit the platinum. However in his publications he does not go into detail either about the platinum or the type of tube which caused the discovery. . . . Only in a later communication, when satisfied with the properties of the new rays and when no one cared much for the history of the discovery, Röntgen mentioned platinum as especially effective, but without even then mentioning the tube with which the discovery was made."

Footnote p. 5. "That tube which Röntgen bought from the glassblower (Müller-Unckel) led him to the discovery of the new rays. At that time I was engaged in an extensive letter exchange with that glassblower in order to instruct him in the manufacture of a workable, unobjectionable tube for me, and Röntgen was very well the first buyer of that tube. The tube sent to me for trials, was very good, but worked only for a short time; it was dirty inside, spoiled the proper vacuum by generating gas, and through constant pumping out of air all comparative observations were made difficult. Nevertheless, I found with the tube signs of unknown occurrences taking place within the surroundings. Unfadable aircurrent effects were noticed up to 30 cm. in front of the window. As it is known now, these were the new rays generated by effects on the platinum. To follow up these observations I received the proper tube only later, at a time when all my experimental work had to be interrupted. (Caused by odd circumstances told in my not yet published "Erinnerungen"). Thus, Röntgen became the main beneficiary of my attempts to manufacture the tube which brought him the discovery of X-rays. Barium platinocyanide with which the above mentioned signs discovered by me could have been followed and interpreted was not available to me."

* Freund, in his article above referred to,[13] also states that it can reasonably be assumed that Röntgen experimented with a Lenard tube because he wrote in "Ueber eine neue Art von Strahlen," " . . . and covers the Lenard apparatus with a tightly fitting coat of thin cardboard" and then crossed out "Lenard apparatus" and wrote instead "the tube." This hardly proved that Röntgen used the Lenard tube exclusively. In correcting his sentence Röntgen no doubt recognized he had named several tubes in the first phrase and that "the tube" would properly refer to any one of them.

eine neue Art von Strahlen"[16] he says, "If one passes a high voltage current through a Hittorf, sufficiently evacuated Lenard, Crookes or other similar apparatus . . . " fluorescence of a barium platinocyanide coated screen in the vicinity of the tube can be observed in a darkened room. Indeed the very sequence in which the names are listed is given as evidence by the physics faculty at Würzburg of the order in which Röntgen first observed x-rays, and this is likely significant.

From what has been said it is evident that Lenard's attitude has been one of gradually developing and increasing animosity through the years, climaxed during the time of his lofty and commanding position in the Nazi hierarchy of scientists. This has been evidenced in many ways beginning with his Nobel Prize lecture. His book "Grosse Naturforscher" containing biographies of great scientists from Pythagoras through the lives of Hittorf, Crookes, Hertz, fails to mention Röntgen, except once incidentally,[17] in the discussion of the work of Hittorf and Crookes thus: "The developments now came quickly one after another, the extent of which can only be signified briefly: The discovery of the high frequency rays (Röntgen-rays) followed . . ." A physics textbook edited by a student of Lenard's at Heidelberg—Tomaschek[18]—deals with x-rays in this brief note: "Röntgenstrahlen. In June, 1895, Röntgen made the observation with a Lenard cathode-ray tube, that on the part of the tube where the cathode rays are stopped new rays are given off that have the property of causing fluorescence of fluorescent material in the neighborhood of the tube and of blackening photographic paper beneath it!"—On page 35 of "Wissenschaftliche Abhandlungen" Lenard speaks, rather than of x-rays or of roentgen rays, of "the discovery of the new rays, that were soon very important in medicine." In his four volume work "Deutsche Physik"[19] there is no mention of Röntgen or Einstein in the text, but the foreword is a lengthy diatribe against the Jews. The implication, drawn by many persons in Germany during recent years, was that Röntgen was a Jew. In answer to my direct query, "Was Röntgen a Jew?," Lenard replied, "No, but he was a friend of Jews and acted like one." Showing further his bias on this subject is a note signed by Lenard on the fly-leaf of Volume 1 of "Deutsche Physik" in the library of the Physical Institute* at Heidelberg saying, "To the Philipp Lenard Institute—should there be room left—among the Jewish and Japanese ghosts."

Of particular interest at this time of the fiftieth anniversary of Röntgen's discovery is the fact that the Physical-Medical Society of Würzburg made application in 1944 to the Nazi Minister of Post and Telegraph to have a memorial stamp made for Röntgen similar to the one issued for Robert Koch and other scientists. But it so happened that the minister—Ohnesorge—had been a physicist and student of Lenard's at Heidelberg. He rejected the request saying the proposal was not in order inasmuch as such an honor was reserved only for the illustrious.

It is clear that Lenard embarked upon and continued a course designed to minimize the work of Röntgen, and to make him appear a bungler who merely happened to make a great discovery. His outstanding position as one of Hitler's "brain-trust" and director of the Physical Institute of one of Germany's great universities added great weight to what he had to say. So, in his intense nationalism, he claimed a lot for Germany and incidentally for himself when he says in "Wissenschaftliche Abhandlungen"[20] more about his tube and his cathode-ray studies, " . . . My researches led during the interruption of my work to the discovery of Röntgen, and then followed Bec-

[16] Röntgen, W. C. Ueber eine neue Art von Strahlen (Vorlaufige Mittheilung). Sitzunsberichte der physikal.-medicin. Gesellschaft., Dec. 28, 1895, p. 132.

[17] Lenard, P. Grosse Naturforscher. J. F. Lehmanns Verlag, München, 1929, p. 288.

[18] Tomaschek. Grimsehls Lehrbuch der Physik. Teubner, Leipsig. Vol. II, Part I, p. 311, 1938.

[19] Lenard, P. Deutsche Physik. Lehmanns, München, 1936.

* The Philipp Lenard Institute. (The library contained many volumes by both Jewish and Japanese physicists.)

[20] Lenard, P. Wissenschaftliche Abhandlungen. Vol. III, p. 1

querel's discovery (radioactivity, 1896), radium by Curies and continually many additional advances." Thus to make it appear that anything further developing in the field of atomic research was directly traceable to his cathode-ray studies. Anyone will agree that such a position is untenable as "every scientist and his work is but the child of his scientific forefathers."[21]

We could hope that Röntgen had written more about the actual mode of the discovery, but he was an extreme introvert and deep thinker and not readily communicative.[22] Once, when at the behest of Dr. Harms, Mrs. Boveri queried Röntgen about the discovery, he became angry and said, "One would almost have to excuse himself if he discovered something." He had plainly stated in his first communication how he made the discovery and had told assistants and associates that he had first worked with Hittorf and Crookes tubes. He considered that was enough.

And there we leave it—with the genius of Röntgen clearly established as the responsible factor in the discovery of x-rays. The contentions, excuses and barbs of Lenard have not been able to shake Röntgen from his secure position as one of the greatest scientists of all time.

Pinewood Farm
Warrendale, Penna.

The author expresses his appreciation to Dr. Otto Glasser for his help with translations and editorial assistance, and to Misses Gertrud Weinberg and Anna Michel of Kassel, Germany, Sgt. Bernard Berger and S/Sgt. Joel Schwab, 115th Gen. Hosp., for invaluable help as translators and interpreters. Thanks are likewise due Prof. Dr. Harms, Director of the Physical Institute University of Würzburg and his assistants of the Physics faculty for their kindness in furnishing much of the material for this article.

[21] Thompson, Sylvanus P. The Röntgen Society, London, Nov. 5, 1897, quoted in "The Physical Foundations of Radiology" edited by Otto Glasser. Also see Glasser, Otto, "The genealogy of the roentgen rays." Am. J. Roentgenol. & Rad. Therapy, 1933, *30*, 180, 349.

[22] Glasser, Otto. Strange repercussions of Röntgen's discovery of the x-rays. *Radiology*, 1945, *45*, 425–427.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Forty-seventh Annual Meeting: Netherland Plaza Hotel, Cincinnati, Ohio, Sept. 17–20, 1946.

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Representatives on American Board of Radiology: Douglas Quick, New York, N. Y., B. P. Widmann, Philadelphia, Pa., F. W. O'Brien, Boston, Mass.

Twenty-ninth Annual Meeting: To be announced.

EDITORIALS

THE ANNUAL MEETING

THE Forty-seventh Annual Meeting of the American Roentgen Ray Society will be held at the Netherland Plaza Hotel, Cincinnati, Ohio, September 17 to 20, 1946. This will be the first time the scientific sessions of the Society have been held since the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America in Chicago in September, 1944.

The choice of Cincinnati as a meeting place is an excellent one as the Netherland Plaza offers splendid facilities for both the Scientific and Commercial Exhibits as well as ample rooms for the Scientific programs and the Instruction Courses. Those who were privileged to attend the meeting of the Society in Cincinnati in 1941 will recall with a great deal of pleasure that meeting, probably one of the best the Society has ever had.

Unfortunately, we will miss some of the familiar faces that were present at that meeting. Among these is our own past president, Dr. William M. Doughty, Dr. Kennon Dunham and Dr. E. R. Bader, all former residents of Cincinnati, who have died since the meeting in 1941.

The President Elect, Dr. Raymond C. Beeler, and his Program Committee have arranged an excellent scientific program which should make a special appeal to all members of the Society and it is expected that in the return of the world to an appreciable state of normality there will be a very large attendance at the forthcoming meeting.

The Instruction Courses which have hitherto been an important feature of the annual meeting will again be offered and these courses are under the direction and leadership of Dr. B. R. Kirklin who has so ably conducted them in the past. The current issue of the JOURNAL carries not only the Preliminary Program but also the schedule of the Instruction Courses. Since the number who can attend these courses is limited, it is urged that those who anticipate taking these courses fill out the order blank at once.

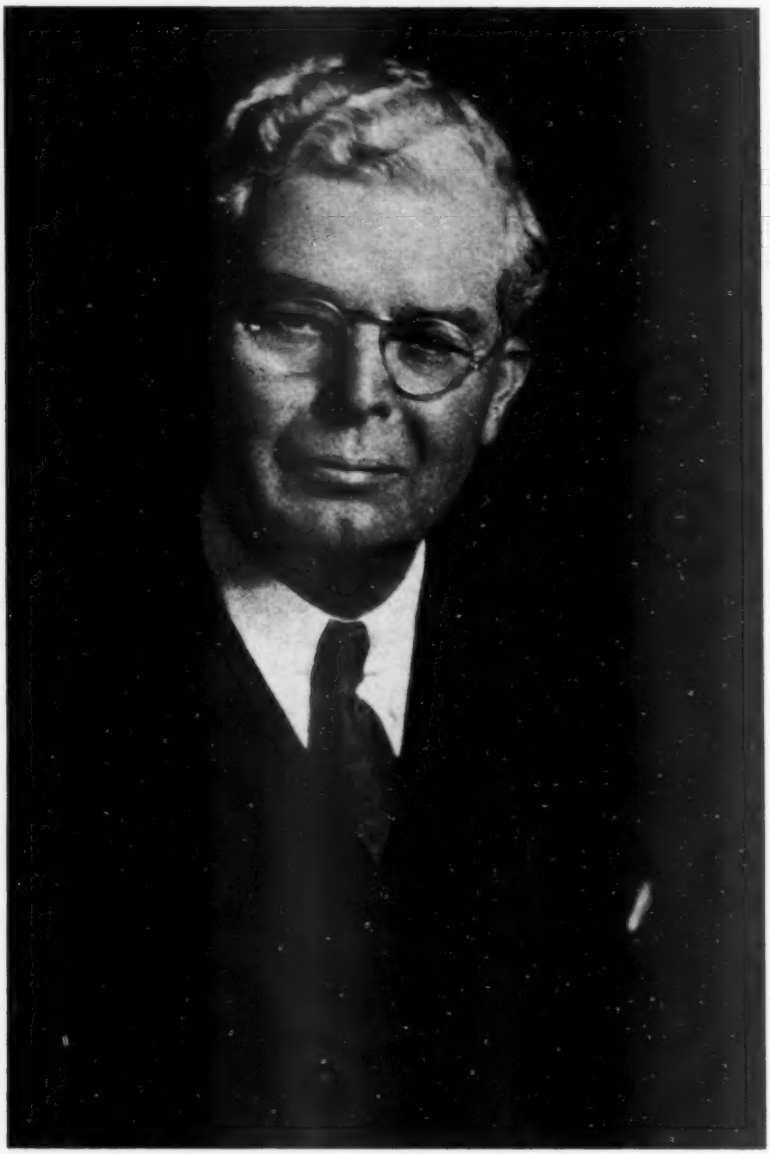
The Chairman of the Scientific Exhibits, Dr. S. W. Donaldson, and his committee have arranged an excellent exhibit, many of them amplifying and extending the papers to be given in the scientific program.

The Commercial Exhibits, which are always of interest, will again be a part of the meeting. They will be considerably enlarged both in numbers and in the quality of the exhibits.

One of the highlights of the program will be the annual Caldwell Lecture which this year will be given by Dr. A. C. Ivy, Professor of Physiology of Northwestern University Medical School, Chicago, Illinois. The title of this lecture is "Motor Dysfunction of the Biliary Tract: An Analytical and Critical Consideration." Dr. Ivy's preeminence in his chosen field is acknowledged and thus this year's Caldwell Lecture on such an important subject is anticipated with a great deal of pleasure.

The social functions which are always a pleasant feature of the annual meetings, particularly those which have been held in Cincinnati, will offer periods of relaxation in the midst of the scientific activities.

All in all, this forthcoming meeting should attract great numbers of radiologists, particularly those who have been in the Armed Forces. In view of this fact, it is urged that all who anticipate attending the meeting make their reservations with the hotel at the earliest possible moment.



ROLLIN HOWARD STEVENS
1868–1946

ONE of the American pioneers and stalwarts in radiology and cancer therapy, Dr. Rollin Howard Stevens, died on May 17, 1946, of acute leukemia, following a comparatively short illness.

Dr. Stevens was born in Blenheim, Ontario, January 7, 1868. By the time he was eighteen years old he had matriculated at the University of Toronto in preparation for a Bachelor's Degree. In 1886 he entered the Homeopathic Medical College of the University of Michigan from which he graduated in 1889. Following his graduation, Dr. Stevens was fully determined to

enter private practice in one of the Canadian communities, but upon learning of a competitive examination to be given for interns at Grace Hospital, Detroit, he offered himself as a candidate and was accepted. His internship at Grace Hospital was completed in 1891. Then followed some post-graduate work at the recently established Leland Stanford Jr. University. He returned to Detroit and became associated again with Grace Hospital and was appointed to the clinical staff. He served successively in this hospital as pathologist, surgeon and gynecologist from 1892 to 1904.

However, his interests were not confined to the usual and accepted medical fields alone. Early in his career he became interested in the use of light therapy in the treatment of tuberculosis. This prompted him to study at the Finsen Institute in Copenhagen where he became particularly interested in dermatological lesions which were improved by the use of radiant energy. Consequently he visited and studied in the leading dermatological clinics in Europe. Upon his return to Detroit he introduced the first Finsen light into American medicine, and in 1904 he was officially transferred to the Dermatological Staff of Grace Hospital and became a lecturer on dermatology to the Homeopathic Medical School of the University of Michigan.

It was fortunate that this period of time coincided with Röntgen's discovery and early use of x-rays, as it introduced to Dr. Stevens another vehicle of therapy. And this was the stimulus for him to establish a Department of Radiology and Dermatology in Grace Hospital, which, incidentally, was one of the first radiological departments in Michigan.

He recognized early in his dermatological investigation the curative effects of light energy in treating malignant lesions of the skin and the similarity of the effects of roentgen rays and radium. This prompted him to secure radium from the Curie Institute in Paris as early as 1903, making him the first man west of New York City to employ radium as a therapeutic agent in the treatment of malignant disease.

He was still a young research worker when he realized that, in order to advance scientifically, it was necessary to have a singleness of purpose and he set his course toward the promotion of radiation therapy in the treatment of malignancies. This remained his life's work and at the time of his death he was an authority in the field of cancer therapy and he was the acknowledged founder of the Detroit Institute of Cancer Research.

Throughout his professional career he endeavored to advance medicine only medically, and he took a very active part in the leading local and national medical societies. He was a faithful attendant at all medical meetings and appeared frequently on their scientific programs with original contributions. In recognition of these activities he was made President of the American College of Radiology, the Radiological Society of North America, the American Radium Society, the Michigan Society of Social Hygiene, the Detroit Roentgen Ray and Radium Society and the Detroit Dermatological Society.

But his efforts were not entirely scientifically directed. He also found time for benevolent and extra-curricular activities, and the many years he devoted to the Boys' Republic—a self-governing home for delinquent boys in Michigan—exemplified his interest in the social welfare of others, and especially the youth.

For his mental and physical relaxation he would make periodic field excursions in search of mushrooms and expeditions after rare mollusks. Not only was he, for years, the President of the Detroit Mycological Society, but he had a national reputation as a mycologist. One variety of mushroom he discovered has been officially named for him—*Helvella stevensii*. Frequently the very early morning hours would find him busy in his garden, tenderly giving the flowers he so dearly loved the attention they required to blossom into his "Garden Beautiful."

In his death, science has lost an enthusi-

astic exponent of cancer therapy and research, but the result of his efforts in establishing radiology as a specialty will live on.

Humanity has lost a friend, but his passing cannot stay the influence of his manifold interests and activities.

Such *was* and *is* Doctor Rollin Howard Stevens!

CLYDE K. HASLEY

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: Netherland Plaza Hotel, Cincinnati, Ohio, Sept. 17–20, 1946.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Mac F. Cahal, 20 N. Wacker Drive, Chicago 6. Annual meeting, 1947: To be announced.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. U. V. Portmann, Cleveland Clinic, Cleveland, Ohio. Annual meeting, 1947: To be announced.

AMERICAN RADIUM SOCIETY
Secretary, Dr. E. H. Skinner, 1532 Professional Bldg., Kansas City, Mo. Annual meeting, 1947: To be announced.

ARKANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: Palmer House, Chicago, Ill., Dec. 1–6, 1946.

RADIOLOGICAL SECTION, BALTIMORE MEDICAL SOCIETY
Secretary, Dr. Walter L. Kilby, Baltimore. Meets third Tuesday each month, September to May.

SECTION ON RADIOLOGY, CALIFORNIA MEDICAL ASSOCIATION
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

RADIOLOGICAL SECTION, CONNECTICUT MEDICAL SOCIETY
Secretary, Dr. Max Climan, 242 Trumbull St., Hartford, Conn. Meets bi-monthly on second Thursday, at place selected by Secretary. Annual meeting in May.

SECTION ON RADIOLOGY, ILLINOIS STATE MEDICAL SOCIETY
Secretary, Dr. H. W. Ackemann, 321 W. State St., Rockford, Ill.

RADIOLOGICAL SECTION, LOS ANGELES CO. MED. ASSN.
Secretary, Dr. Roy W. Johnson, 1407 S. Hope St., Los Angeles, Calif. Meets on second Wednesday of each month at the County Society Building.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. Roy G. Giles, Temple, Texas.

BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. A. H. Levy, 1354 Carroll St., Brooklyn 13, N. Y. Meets monthly on fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY
Secretary, Dr. Joseph S. Gian-Francheschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. F. H. Squire, 1754 W. Congress St., Chicago 12, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

CINCINNATI RADIOLOGICAL SOCIETY
Secretary, Dr. Samuel Brown, 707 Race St., Cincinnati, Ohio. Meets third Tuesday of each month, October to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Carroll C. Dundon, 11311 Shaker Blvd., Cleveland, Ohio. Meetings at 6:30 P.M. on fourth Monday of each month from October to April.

DALLAS-FORT WORTH ROENTGEN STUDY CLUB
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

DENVER RADIOLOGICAL CLUB
Secretary, Dr. A. Page Jackson, Jr., 1612 Tremont Place, Denver, Colo. Meets third Friday of each month at Denver Athletic Club.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

FLORIDA RADIOLOGICAL SOCIETY
Secretary, Dr. J. M. Dell, Jr., 333 W. Main St., S., Gainesville, Fla. Meetings in May and November.

GEORGIA RADIOLOGICAL SOCIETY
Secretary, Dr. James J. Clark, 478 Peachtree St., Atlanta, Ga. Meets in November and at annual meeting of Medical Association of Georgia in the spring.

RADIOLOGICAL SOCIETY OF KANSAS CITY
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. A. Campbell, Indiana University Hospitals, Indianapolis 7. Meets annually second Sunday in May.

IOWA X-RAY CLUB
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

KENTUCKY RADIOLOGICAL SOCIETY
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

LONG ISLAND RADIOLOGICAL SOCIETY
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:30 P.M.

LOUISIANA RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS
Secretary, Dr. E. M. Shebesta, 1429 David Whitney Bldg., Detroit. Three meetings a year, Fall, Winter, Spring.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave., Milwaukee, Wis. Meets monthly on second Monday at University Club.

MINNESOTA RADIOLOGICAL SOCIETY
Secretary, Dr. Annette T. Stenstrom, 1218 Medical Arts Bldg., Minneapolis, Minn. One meeting a year at time of Minnesota State Medical Association.

NEBRASKA RADIOLOGICAL SOCIETY
Secretary, Dr. D. A. Dowell, Medical Arts Bldg., Omaha, Neb. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Boston Medical Library

NEW HAMPSHIRE ROENTGEN RAY SOCIETY
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

RADIOLOGICAL SOCIETY OF NEW JERSEY
Secretary, Dr. W. H. Seward, Orange Memorial Hospital, Orange, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

NORTH CAROLINA ROENTGEN RAY SOCIETY
Secretary, Dr. Major Fleming, Rocky Mount, N. C.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

North Dakota Radiological Society
Secretary, Dr. L. A. Nash, St. John's Hospital, Fargo. Meetings held by announcement.

Central New York Roentgen Ray Society
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse. Three meetings a year. January, May, November.

Ohio Radiological Society
Secretary, Dr. Henry Snow, 1061 Reibold Bldg., Dayton, Ohio. Meets during annual meeting of Ohio State Medical Association.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. L. E. Wurster, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. C. L. Stewart, Jefferson Hospital. Meets first Thursday of each month, October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. L. M. J. Freedman, 4800 Friendship Ave. Meets 6:30 P.M. at The Ruskin on second Wednesday, each month, October to May inclusive.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Murray P. George, Strong Memorial Hospital. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary Dr. A. M. Popma, 220 N. First St., Boise, Idaho. Mid-Summer Conference, August 8, 9, 10, 1946, at Shirley Savoy Hotel, Denver, Colorado.

St. Louis Society of Radiologists
Secretary, Dr. Edwin C. Ernst, Beaumont Medical Building, St. Louis, Mo. Meets fourth Wednesday of each month, except June, July, August, and September.

San Diego Roentgen Society
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly on first Wednesday at dinner.

San Francisco Radiological Society
Secretary, Dr. Joseph Levitin, 516 Sutter St., San Francisco 2, Calif. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year at Lane Hall, Stanford University Hospital, and second six months at Toland Hall, University of California Hospital.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets every Thursday from 4:00–5:00 P.M., Room 301, Service Memorial Institute.

Virginia Radiological Society
Secretary, Dr. E. L. Flanagan, 116 E. Franklin St., Richmond, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. Thomas Carlile, 1115 Terry St., Seattle. Meets fourth Monday each month, October through May, College Club, Seattle.

X-Ray Study Club of San Francisco
Secretary, Dr. J. M. Robinson, University of California Hospital. Meets monthly, third Thursday evening.

Cuba

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Mexico

Sociedad Mexicana de Radiolcgia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

British Empire

British Institute of Radiology Incorporated with the Roentgen Society
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

Faculty of Radiologists
Secretary, Dr. M. H. Jupe, 23 Welbeck St., London, W.1 England.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Keith Hallam, St. George's Hospital, K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to November inclusive.

Canadian Association of Radiologists
Secretary, Dr. J. W. McKay, 1620 Cedar Ave., Montreal.

Société Canadienne-Francaise d'Electrologie et de Radiologie Médicales
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Radiological Section, New Zealand British Medical Association
Secretary, Dr. Colin Anderson, Invercargill, New Zealand. Meets annually.

South America

Sociedad Argentina de Radiologia
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

Sociedad Peruana de Radiologia
Secretary, Dr. Victor Giannoni, Apartado, 2306, Lima, Peru. Meetings held monthly except during January, February and March, at the Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

Continental Europe

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. Babaiantz, Geneva.
Secretary for German language, Dr. Max Hopf, Effingerstrasse 49, Bern. Meets annually in different cities.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banul Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad: USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

PRELIMINARY PROGRAM

FORTY-SEVENTH ANNUAL MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY

The Forty-seventh Annual Meeting of the American Roentgen Ray Society will be held at the Netherland Plaza Hotel, Cincinnati, Ohio, on September 17, 18, 19 and 20, 1946.

The Executive Council will meet at noon on Sunday, September 15.

The annual Golf Tournament for the Willis F. Manges Trophy will be held on Monday, September 16, at the Hyde Park Golf and Country Club.

The Caldwell Lecture will be given on Tuesday evening, September 18, and the Annual Banquet will be held on Thursday evening, September 19.

The Instruction Courses will be given at 8:00 A.M. and 9:30 A.M. each day of the meeting and elsewhere in this issue will be found the detailed plan of the courses.

The scientific program has been arranged as follows:

Tuesday, September 17, 1946

8:00 A.M. Instruction Courses.

11:00 A.M. Call to Order, Forty-seventh Annual Meeting. Ross Golden, M.D., President.

Installation of the President-Elect, Raymond C. Beeler, M.D., Indianapolis, Ind., by President Golden and the Chairman of the Executive Council, Charles M. Richards, M.D., San Jose, Calif.

Inaugural Address: "Radiology in the Atomic Age." President Raymond C. Beeler, M.D.

11:20 A.M.

Paper No.

1. The Roentgen Diagnosis of Diaphragmatic Hernia. B. R. Kirklin, M.D., and John R. Hodgson, M.D. (by invitation) Rochester, Minn.

2:00 P.M.

2. The Crater in Uncomplicated Duodenal Ulcer—Its Significance in Diagnosis and Treatment. Frederic C. Templeton, M.D., Seattle, Wash.
3. Post-bulbar Ulcers of the Duodenum. Robert P. Ball, M.D., and Allan Seagel, M.D. (by invitation), New York, N. Y.
4. Psychosomatic Relationships in Duodenal Ulcer. Herbert S. Gaskill, M.D. (by invitation), Philadelphia, Pa.

Discussion of papers 2–4 to be opened by Joseph C. Bell, M.D., Louisville, Ky., and B. R. Kirklin, M.D., Rochester, Minn.

5. Results of Treatment of Carcinoma of the Cervix in General, and by the Intravaginal Method in Particular. Ralph M. Caulk, M.D. (by invitation), and Edwin A. Merritt, M.D.,* Washington, D. C.

Discussion to be opened by Arthur W. Erskine, M.D., Cedar Rapids, Iowa.

6. Analysis of Technical Factors Involved in Treatment of Carcinoma of the Cervix Uteri. G. E. Richards, M.D., Toronto, Canada.

Discussion to be opened by Charles L. Martin, M.D., Dallas, Texas.

7. Roentgen Therapy in Uterine Fibromyomata without Ovarian Sterilization. George E. Pfahler, M.D., Philadelphia, Pa.

Discussion to be opened by Edwin C. Ernst, M.D., St. Louis, Mo.

4:30 P.M. Executive Business Session of the Society.

Tuesday Evening, September 17, 1946

Eight-Thirty O'Clock
The Caldwell Lecture
A. C. Ivy, Ph.D., M.D.

Nathan Smith Davis Professor of Physiology, Northwestern University Medical School, Chicago, Illinois

"Motor Dysfunction of the Biliary Tract: An Analytical and Critical Consideration"
Introduction—James T. Case, M.D., Chicago, Illinois

Wednesday, September 18, 1946

8:00 A.M. Instruction Courses.

* Deceased.

11:00 A.M.

8. Bronchography in Children. Eduardo Rivero, M.D. (by invitation), Havana, Cuba.
   Discussion to be opened by Ross Golden, M.D., New York, N. Y.
9. Body Section Roentgenography in Carcinoma of the Lung. Leo G. Rigler, M.D., Minneapolis, Minn., and T. B. Werner, M.D. (by invitation).
   Discussion to be opened by Sherwood Moore, M.D., St. Louis, Mo.

2:00 P.M.

10. Angiography in the Diagnosis of Intracranial Lesions. Philip J. Hodes, M.D., C. R. Perryman, M.D., and R. H. Chamberlain, M.D., Philadelphia, Pa.
    Discussion by Fred J. Hodges, M.D., Ann Arbor, Mich.
11. Angiocardiography in Mediastinal Tumors. Marcy L. Sussman, M.D., New York, N. Y.
    Discussion by Merrill C. Sosman, M.D., Boston, Mass.
12. Abdominal Aortography, Paul C. Swenson, M.D., and Fred B. Wagner, M.D. (by invitation), Philadelphia, Pa.
    Discussion by P. L. Fariñas, Havana, Cuba.
13. Abdominal Venography. Pedro L. Fariñas, M.D. (by invitation), Havana, Cuba.
    Discussion by Leo G. Rigler, M.D., Minneapolis, Minn.
14. Problems in Venography, Edgar G. Baker, M.D., Youngstown, Ohio.
15. Roentgenologic Findings in Myasthenia Gravis Associated with Thymic Tumor. C. Allen Good, M.D., Rochester, Minn.
    Discussion to be opened by Aubrey O. Hampton, M.D., Washington, D. C.
16. Benign Histoplasmosis and Pulmonary Calcification. Amos Christie, M.D. (by invitation), and J. C. Peterson, M.D. (by invitation), Nashville, Tenn.
    Discussion to be opened by L. R. Sante, M.D., St. Louis, Mo.
17. The Comparative Efficiency of Mass Roentgenography Methods. Herman E. Hilleboe, M.D. (by invitation), Washington, D. C., and Russell H. Morgan, M.D. (by invitation), Chicago, Ill.
    Discussion to be opened by W. E. Chamberlain, M.D., Philadelphia, Pa.
18. Benign Pneumoconiosis Due to Metal Fumes and Dusts. O. A. Sander, M. D. (by invitation), Milwaukee, Wis.
    Discussion to be opened by Hollis E. Potter, M.D., Chicago, Ill.

Thursday, September 19, 1946

8:00 A.M. Instruction Courses.

11:00 A.M.

19. The Roentgen Diagnosis of Congenital Cardiovascular Abnormalities Amenable to Surgery. Edward B. D. Neuhauser, M.D. (by invitation), Boston, Mass.
20. The Physiopathology of Congenital Heart Disease. Richard J. Bing, M.D. (by invitation), Baltimore, Md.
    Discussion of papers 19 and 20 to be opened by Merrill C. Sosman, M.D., Boston, Mass.

2:00 P.M.

21. Radioactive Sodium as a Tool in Medical Research. Edith H. Quimby, Sc.D., New York, N. Y.
22. Principles of Tissue Dosage in Radioisotope Therapy. Robley D. Evans, Ph.D. (by invitation), Boston, Mass.
23. Radioactive Phosphorus as a Therapeutic Agent. Edward H. Reinhard, M.D. (by invitation), St. Louis, Mo.
24. Medical Uses of Radioactive Iodine. Earl Miller, M.D. (by invitation), San Francisco, Calif.
25. Comparative Therapeutic Effects of Radioactive and Chemical Agents in Neoplastic Diseases of the Hemopoietic System. A. M. Brues, M.D. (by invitation), and L. O. Jacobson, M.D. (by invitation), Chicago, Ill.
    Discussion by G. Failla, Sc.D., New York, N. Y., R. E. Zirkle, Ph.D., Chicago, Ill., and L.O. Jacobson, M.D. Chicago, Ill.
26. The Standardization of Roentgen-Ray Tubes and Cables. Russell H. Morgan, M.D. (by invitation), Chicago, Ill.
    Discussion to be opened by Paul C. Hodges, M.D., Chicago, Ill.

4:30 P.M. Executive Business Session of the Society.

Thursday Evening, September 19, 1946

Seven-Thirty O'Clock
Annual Banquet

Friday, September 20, 1946

8:00 A.M. Instruction Courses.

11:00 A.M.

27. Pulmonary Tubercles or Nodules. Lewis Gregory Cole, M.D., White Plains, N.Y.
Discussion to be opened by E. P. Pendergrass, M.D., Philadelphia, Pa.
28. Pulmonary Disease Due to Friedländer Bacillus. Carleton B. Peirce, M.D., Montreal, Canada, and Dso Li-Liang, M.D. (by invitation).
Discussion to be opened by M. A Blankenhorn, M.D., Cincinnati, Ohio.

2:00 P.M.

29. Preliminary Studies on the Biological Effects of 20,000,000 Volt Radiation. Jack T. Wilson, Ph.D., Milwaukee, Wis.
30. The Therapeutic Application of Induction Electron Accelerators. E. E. Charlton, Ph. D., Schenectady, N. Y.
Discussion of papers 29 and 30 to be opened by Henry Quastler, M.D., Urbana, Ill.
31. Comparative Value of Deep and Supervoltage Roentgen Therapy. T. Leucutia, M.D., Detroit, Mich.
Discussion to be opened by U. V. Portmann, M.D., Cleveland, Ohio.
32. Supervoltage Radiation. George W. Holmes, M.D., and Milford D. Schulz, M.D. (by invitation), Boston, Mass.
Discussion to be opened by David Steel, M.D., Cleveland, Ohio.
33. The Use of High Voltage Roentgen Therapy in the Treatment of Amenorrhea and Sterility in Women. Ira I. Kaplan, M.D., New York, N. Y.
Discussion to be opened by William Harris, M.D., New York, N. Y.
34. Fibrous Dysplasia of Bone. Franklin B. Bogart, M.D., Chattanooga, Tenn., and Allison E. Imler, M.D. (by invitation), Birmingham, Ala.
Discussion to be opened by Ralph S., Bromer, M.D., Bryn Mawr, Pa.
35. Congenital Malformations Induced in Rats by Roentgen Rays; Skeletal Changes in the Offspring Following a Single Irradiation of the Mother. Josef Warkany, M.D. (by invitation), and Elizabeth Schraffenberger, M.D. (by invitation), Cincinnati, Ohio.

AMERICAN ROENTGEN RAY SOCIETY

SECTION ON INSTRUCTION

B. R. Kirklin, M.D., *Director*

Abstracts of Courses Offered

Forty-seventh Annual Meeting
Netherland Plaza Hotel, Cincinnati, Ohio
September 17–20, 1946

President-Elect Beeler, with the approval of the Executive Council, has directed that the Section on Instruction be continued for the 1946 annual meeting. He has arranged his program so that the instruction courses will be given between the hours of 8:00 A.M. and 10:45 A.M. on Tuesday, Wednesday and Thursday, and 8:00 A.M. and 9:15 A.M. on Friday. Nothing else will be scheduled during these hours, thus allowing everyone at the meeting to attend the Instruction Courses each morning.

This Section presents for 1946:

1. Four special Sequential Courses, lettered "A" to "D," with a faculty of four instructors and covering eleven periods.
2. Eight single-period courses on Radiation Physics, with a faculty of eight instructors and covering eight periods.
3. Thirteen single-period courses on Therapeutic Radiology, with a faculty of thirteen instructors and covering sixteen periods.
4. Twenty-nine single-period courses on Diagnostic Roentgenology, with a faculty of thirty-one instructors and covering thirty-five periods.

GENERAL INFORMATION

Conference Periods

Tuesday, Wednesday, Thursday and Friday mornings

First period.....8:00 to 9:15
Second period.....9:30 to 10:45

Location

All courses will be given in parlors A to J located on the fourth floor of the Netherland Plaza Hotel. Full information may be secured at the general registration desk which will be located nearby.

Code

The instruction periods will be designated with the following code:

T-1	Tuesday, first period	8:00 to 9:15
T-2	Tuesday, second period	9:30 to 10:45
W-1	Wednesday, first period	8:00 to 9:15
W-2	Wednesday, second period	9:30 to 10:45
Th-1	Thursday, first period	8:00 to 9:15
Th-2	Thursday, second period	9:30 to 10:45
F-1	Friday, first period	8:00 to 9:15

(Familiarity with this code will avoid much confusion)

How To Secure Tickets for Instruction Courses

Admission to the Instruction Courses will be by ticket only.

Following the abstracts of the courses will be found a general order sheet. First, second and third choices for each period should be carefully selected as the number attending each course given during these periods will be limited to from thirty to forty persons. If directions as given on the order sheet are followed explicitly, errors in completing reservations will be minimized.

If you are requesting registration in one or more of the Special Sequential (continuous) Courses, please indicate for each period your second and third choices of individual single-period courses as substitutes —to avoid disappointment should the Sequential Courses be filled when your order is received.

It is possible for one to attend only seven periods of instruction, so the condensed

schedule should be noted carefully in arranging individual orders for tickets.

Reservations will be made in the order of receipt of the order forms. Those who are not members of the American Roentgen Ray Society will be charged a nominal fee of $1.00 per period, or a maximum fee of $5.00 for five or more periods. Full time graduate students in Radiology will be admitted without fee.

Previous to September 7, send orders to Rochester, Minnesota; after September 7, send orders directly to Dr. B. R. Kirklin, Netherland Plaza Hotel, Cincinnati, Ohio.

If the courses are not filled by the time of the meeting, tickets will be available at the registration desk, located on the Fourth Floor, on Sunday, September 15, and thereafter during the meeting.

Holders of Tickets

Those who do not have a proper ticket for the assigned course will not be permitted to enter the room. Pages will be assigned to each conference room to collect tickets.

Duplications and Repeats

Due to the anticipated heavy registration a few of the single-period courses will be repeated and others will be duplicated by two or more instructors.

SEQUENTIAL COURSES

COURSE: A
(2 periods)

Room: A **Periods: Th-2; F-1**

S. W. DONALDSON, M.D., Ann Arbor, Michigan

Medical Jurisprudence as Applied to Radiology

This course will take into consideration the relationship between physician and patient and the various contracts entered into between them. Malpractice will be defined and consideration given to all acts of the radiologist that may be subject to allegation of negligence or other grounds for suit. The Law of Agency will be discussed and its application to the radiologist in regard to his liability for the acts of those employed by him. Pointers will be given about malpractice defense and prophylaxis. The legal requirements for the introduction of films as evidence in courts of law will also be taken up as well as that for physician's records and hospital records. There will be discussion of privileged communications as related to roentgen examinations, the admissibility of evidence, expert testimony, expert witness fees, and court room procedure for the witness.

COURSE: B
(3 periods)

Room: G **Periods: T-1; W-1; Th-2**

ROSS GOLDEN, M.D., New York City

Roentgenology of the Small Intestine

Tuesday

- Technique
- Normal small intestine
  - Anatomy
  - Physiology
- Indications for small intestine study
- Diverticula
- Disturbances in physiology
  - Emotion
  - Vagotonia
  - Multiple peritoneal adhesions
- Developmental anomalies
  - Internal hernia
  - Congenital diaphragm
- Effect of disease of the mesentery
  - Localized
  - Generalized
    - Lymphoblastoma
    - Sclerosing mesenteritis

Wednesday

- The "Deficiency Pattern"
  - Vitamin deficiency states
  - Hypoproteinemia
  - Biliary tract disease
  - Pancreatic disease
- Allergy
- Inflammations
  - Tuberculous
  - Non-tuberculous
    - Sclerosing regional enteritis
    - Non-sclerosing regional enteritis

Thursday

- Neoplasms
  - Benign
  - Malignant
    - Carcinoma and carcinoid
  - Lymphosarcoma
    - Localized
    - Diffuse
- Benign ulcer

Ileus
- Diagnosis by 3 position abdominal films
  - Paralytic
  - Mechanical
  - Mesenteric vascular occlusion
- The Miller-Abbott tube
  - Technique of insertion
  - Deflation
  - Injection of barium for
    1. Localization
    2. Demonstration of type of obstruction
  - Complications

COURSE: C
(4 periods)

Room: H **Periods: T-1; W-1; Th-1; F-1**

W. WALTER WASSON, M.D., Denver, Colo.

The Anatomy, Physiology, and Mechanics of the Chest as a Basis for the Study of Chest Diseases and Their Classification

This is an effort to portray the chest so that the clinician or radiologist can actually visualize the thoracic viscera and their diseases. A child begins life with certain anatomical structures which change with the years both as a result of physiological processes and disease. The pathological reactions which the clinician or the radiologist is called upon to diagnose are definitely influenced by the particular physiology and mechanics of this anatomy. Accordingly, any classification of chest disease must be based upon the pathological reactions of disease as influenced by anatomy and of the physiology and mechanics of this anatomy.

The presentation will be made in the following sections:

1. Anatomy of the Lungs. Period: T-1
2. Physiology and Mechanics of the Chest and Particularly of the Lungs. Period: W-1
3. The Classification of Diseases of the Lungs. Period: Th-1
4. Illustrations of the Different Diseases of the Lungs and their Diagnosis. Period: F-1

COURSE: D
(2 periods)

Room: A **Periods: Th-2; F-1**

FEDERICO GARCIA CAPURRO, M.D., Montevideo, Uruguay

Topographical Roentgenological Diagnosis of the Tumors of the Abdomen

This course will take into consideration the fundamental principles of the topographical diagnosis of the tumors of the abdomen, including those of the gastrointestinal tract.

Consideration of the Fundamentals of Topographical Diagnosis Period: Th-2

1. *Peritoneal embryogenesis* and its influence on the anatomical displacements produced by the tumoral expansion.
2. *Roentgenological concepts of the topographical anatomy of the abdomen.* Outline of the three anatomical systems of viscera. The fixed points of the anatomy or "landmarks" of the topographical diagnosis.
3. *The physical equilibrium of the abdomen* and its relation to the displacements produced by the tumors.
4. *Technique of roentgenological procedure.* The dynamic roentgenology.

The Topographical Syndromes. Period: F-1

The different tumors of the regions into which the abdomen is divided for practical purposes of clinical examination will be considered from the viewpoint of establishing the differential diagnosis.

The fundamental principles involved in this type of diagnosis will be illustrated with lantern slides.

SINGLE PERIOD COURSES

RADIATION PHYSICS

COURSE: 101

Room: E **Period: T-1**

CARL B. BRAESTRUP, Ph.D., New York City

Common Causes of Radiation Hazards in Roentgenology

Radiation injuries are caused mainly by faulty equipment, inadequate structural shielding or improper operating procedures.

Equipment. Most improvements in roentgen-ray equipment have been in the direction of greater safety. Thus the protective tube housing practically limits the radiation to the useful beam. On the other hand, the important progress made in roentgen-ray tube design has so greatly increased the available dosage rate that permanent skin injuries may be produced in a few seconds. It is important, therefore, that roentgen therapy equipment be provided with accurate means for the control of the dose.

The protection afforded the patient, the radiologist and attendants during fluoroscopy depends to a large extent upon the construction of the fluoroscope. The use of large target-panel distances and adequate filtration reduces materially the exposure to the patient. The dose received by the fluoroscopist can be cut down considerably by proper diaphragming

of the useful beam and ample shielding against scattered radiation.

Structural Shielding. The use of protective equipment has often produced a false sense of security especially where the equipment is represented as "ray-proof." Obviously barriers must be provided against the useful beam and resultant scattered radiation. Radiation injuries due to inadequate structural shielding seldom manifest themselves for years when permanent damage has already been done. No roentgen-ray installations, therefore, should be considered safe until so established by ionization measurements or similar tests.

Operating Procedures. Most radiation injuries can be ascribed to the failure of the human element, caused either by carelessness or lack of understanding of the protection problem. Fracture setting under fluoroscopy is probably the greatest cause of radiation injuries in diagnostic roentgenology. The greatest radiation hazard in therapy is the omission of the proper filter. Another frequent cause of overexposure of the patient is the incorrect use of ionization instruments.

Actual cases of radiation hazards will be presented to demonstrate that no roentgen-ray installation is safe unless properly used.

COURSE: 102

Room: E **Period: W-1**

G. FAILLA, Ph.D., New York City

Dosage Problems in the Use of Radioactive Isotopes

Radioactive isotopes. Availability and possible uses as tracers and for therapy.

Discussion of physical characteristics (activity, half-life, type and energy of radiation).

Tissue dosage determinations: (1) when used in "applicators" as in the case of radium or radon; (2) when introduced into the body as chemical compounds.

Influence of rate of decay, elimination, local concentration.

Dangers in the use of radioactive isotopes internally administered.

Protection of personnel.

Dosage data and charts will be presented.

COURSE: 103

Room: E **Period: W-2**

OTTO GLASSER Ph.D., Cleveland, Ohio

Atomic Energy in Radiology

A short historical account of the development of both electronic energy and nuclear energy will be presented, starting with the discovery of the roentgen ray in 1895. From the wealth of information on the structure of the atom and its inherent energy those facts and problems will be selected which are of special interest to the radiologist. Such facts comprise the production of roentgen rays at supervoltages, production of fast electron streams, chipping and smashing of atoms, production of radioactive tracers and fission particles. Problems comprise application of short wave roentgen rays and fast electrons in biological work, use of radioactive isotopes for diagnostic and therapeutic purposes and practical aspects of energies released by fission.

COURSE: 104

Room: E **Period: T-2**

GEORGE C. HENNY, M.Sc., M.D., Philadelphia, Pa.

Roentgen Film Characteristics and the Practical Calibration of Roentgenographic Apparatus and Processing Solutions

The characteristics of the roentgen film emulsion (together with intensifying screens if they are used), in which the roentgenologist is mainly concerned, are the "speed" and the "contrast." These characteristics are of great importance.

The "speed" determines the degree of darkening of the processed film, after standard development, for a given roentgenographic exposure and a particular anatomic part.

The "contrast," under the same conditions, determines the degree to which tissue density-differences and thickness-differences of the anatomic part will be recorded on the roentgenogram.

For uniformity of results the roentgenographic apparatus and processing solutions should be calibrated at regular intervals. Fairly simple methods of calibration, which are accurate enough for the purpose, are described and may be employed in the roentgen department without great outlay of time or money. When properly employed the roentgenograms of a given patient show uniform density from one examination to the next and the detail of the anatomic parts being studied is, as far as the film emulsion is concerned, brought out to the greatest degree.

COURSE: 105

Room: E **Period: Th-2**

EDITH H. QUIMBY, Sc.D., New York City

Dosage Calculations in Radium Therapy

The development of dosage units for radium therapy will be traced briefly. Various charts and tables for determination of dosage in roentgens will be presented. Most of the period will be devoted to working out practical problems.

COURSE: 106

Room: E **Period: Th-1**

LAURISTON S. TAYLOR, Ph.D.,
Washington, D. C.

Ionization Chambers and Their Uses

A non-technical discussion will be given on the uses and limitations of various types of ionization chambers. The clinical applications of the thimble chamber will be discussed pointing out the limitations in its use, the methods of making corrections in measurements, and the general factors which enter into the measurements. The problem of measuring very soft roentgen rays by means of special ionization chambers will also be discussed. The measurement of megavolt radiation and gamma rays together with the instrumental limitations will be developed together with the means of applying corrections to the clinical measurements that may be made.

COURSE: 107

Room: E **Period: F-1**

J. L. WEATHERWAX, M.S., Philadelphia, Pa.

Dosage Calculations in Roentgen Therapy

1. Comparison of roentgens measured in air, on the skin and at a depth in a phantom or tissue.
2. Factors influencing backscatter to skin portals.
3. Factors influencing penetration into the tissue.
4. Depth dose charts and a study of the intensity tables as found in "Physical Foundations of Radiology."
5. Study of contact therapy as to quality, penetration and radiation distribution.
6. A short discussion of supervoltage radiation therapy. (If time permits.)
7. Methods of estimating tumor dose in tissue roentgens.

COURSE: 108

Room: F **Period: T-2**

MARVIN M. D. WILLIAMS, Ph.D.,
Rochester, Minnesota

Roentgen-Ray Circuits and Apparatus

The effect of voltage and current and their wave forms on the quality and dosage rate of radiation will be briefly reviewed. The common circuits used in roentgenographic and therapy machines will be illustrated, and the voltage and current wave forms produced by each will be shown on an oscillograph. The effect on voltage wave form produced by certain changes in equipment will be shown and the resultant effect on radiation output discussed.

THERAPEUTIC RADIOLOGY

COURSE 201

Room: J **Period: Th-1**

E. C. ERNST, M.D., St. Louis, Mo.

Practical Concepts of Radiation Treatment of Carcinoma of the Cervix Uteri

SYNOPSIS

(a) *Clinical Management and Preliminary Considerations*
(b) *Indications for Roentgen Therapy:*
   1. Indirect irradiation of the pelvis.
   2. Direct (intravaginal) roentgen-ray applications.
(c) *Essential Tumor Dose Measurement Factors*
(d) *Indications for Radium Therapy:*
   1. Evaluation of the various methods and the intracervical applicators.
   2. Essential minimum requirements for obtaining the ideal uniform distribution of radium radiations.
(e) *Prognostic Factors:*
   1. Tumor grading.
   2. Stage of the disease.
   3. Initial response to preliminary roentgen irradiation.
(f) *Final Discussion Period:*
   1. Case presentations.
   2. Questions (15 minutes).

ABSTRACT

The practical irradiation management of carcinoma of the cervix will be discussed both from the standpoint of the institutional tumor clinic and the private office procedure. Although realizing that the radiation treatment standards continue to remain somewhat in a state of flux and that individualization in the application of roentgen rays and radium is a most essential consideration, nevertheless certain fundamental concepts in our routine procedures are most helpful in the management of cancer of the cervix. These and many other practical therapeutic considerations, including external roentgen therapy, intracavity radium and roentgen methods of treatment and the dosage measurement problems, will be discussed and illustrated.

COURSE: 202

Room: F **Period: T-1**

ROBERT E. FRICKE MD.,
Rochester, Minnesota

Radium Therapy for Nonmalignant Conditions

While the more urgent control of cancer occupies most of the energies of the physician employing radium, a surprisingly large number of nonmalignant conditions have been found to respond readily to

radium therapy. These nonmalignant diseases form quite a heterogeneous group and are very interesting; some are very widespread and others are quite rare. During the past several years, the number of patients treated with radium at the Mayo Clinic for benign conditions has averaged 45 to 48 per cent of the total. These patients were treated for nonmalignant disorders in the realms of otolaryngology, gynecology, pediatrics, urology, dermatology, ophthalmology and surgery.

Discussion of these interesting conditions will be illustrated by slides and some of the radium applicators will be exhibited when discussing technique.

COURSE: 203

Room: D **Periods: Th-1; F-1**

MILTON FRIEDMAN, M.D., New York City

Supervoltage Roentgen Therapy

The increasing use of supervoltage roentgen therapy necessitates reorientation of certain concepts in radiotherapy. Since skin damage is no longer a major obstacle, the principle of "giving as much as the skin can stand" is no longer a guide. It now becomes necessary to ascertain the specific lethal tumor dose for the lesion being irradiated, and the tolerance dose of the adjacent normal structures, which varies considerably for different organs.

Physical characteristics of a beam of supervoltage radiation will be discussed from the standpoint of clinical applications.

The methods of ascertaining the tumor dose of the lesion under treatment will be discussed, including principles of interpretation of quantitative cytologic destruction in biopsies taken during treatment.

Finally specific tumors will be discussed from the standpoint of (1) radioincurable lesions which are brought within range of radiocurability by supervoltage roentgen therapy; (2) lesions ordinarily treated with 200 kv., which can be more efficiently treated with supervoltage radiation; and (3) improved palliation obtained with supervoltage radiation.

COURSE: 204

Room: D **Period: W-2**

H. DABNEY KERR, M.D., Iowa City, Iowa

Irradiation of Malignant Tumors of the Pelvis

This will be a general discussion of the problem of delivering "adequate" doses of radiation to pelvic lesions, especially carcinoma of the cervix. It will necessarily have to include reference to basic physical problems or irradiation. The technique of irradiation in use currently at the State University of Iowa will be presented not as a fixed method but as one which seems to be working effectively. There will also be a discussion of local and general complications, including osseous damage.

COURSE: 205

Room: D **Period: Th-2**

MAURICE LENZ, M.D., New York City

Roentgen Therapy of Lymphosarcoma

The result of roentgen therapy of lymphosarcoma varies with inherent clinical characteristics, microscopic structure, assumed primary site, extent on admission and tumor dosage.

A detailed analysis will be given of the experience with this treatment at the Presbyterian Hospital, New York.

COURSE: 206

Room: B **Period: Th-2**

T. LEUCUTIA, M.D., Detroit, Mich.

Radiation Therapy of Bone Tumors

(1) Osteogenic sarcoma. Radiation therapy is used in association with surgery in pre- or postoperative form in all types, except the pure osteolytic type, in which it is used alone. In the inoperable group, irradiation produces definite symptomatic relief. The five year survival for the entire series amounts to 17 per cent.

(2) Giant cell tumor. Here radiation therapy is the method of choice. There are two requisities: (*a*) irradiation must be carried out with gradually decreasing doses for nearly two years, and (*b*) a limited use of the affected bone must be made so as to prevent marked demineralization from disuse. The final results are, with few exceptions, good.

(3) Ewing's tumor. In the very early cases, radiation therapy may lead to occasional five year survival; in the others, only palliation is obtained, although the immediate response is often striking.

(4) Multiple myeloma. Radiation therapy leads to limited symptomatic relief, but no cure is possible.

(5) In the group of benign tumors, radiation therapy is of definite value in chondroma, myxoma, hemangioma, cystic conditions, etc.

The detailed procedure is presented in the various groups and the technique of irradiation illustrated. Final statistical data are included.

COURSE: 207

Room: D **Periods: T-1; W-1**

CHARLES L. MARTIN, M.D., Dallas, Texas

Complete Care of Cancer of Mouth and Lip Including Cervical Metastases with Irradiation Alone

A plan for the complete radiological care of all stages of cancer of the mouth and lip will be de-

scribed. Although both radium and roentgen rays are used, the equipment is relatively inexpensive and the time of treatment is short. Much emphasis will be placed on the intensive irradiation of metastatic cervical glands, using a combined roentgen-ray and interstitial radium technique, which has yielded some very promising results. Detailed descriptions of the procedure used in a number of actual cases have been prepared for presentation.

COURSE: 208

Room: D **Period: T-2**

WILLIAM S. NEWCOMET, M.D., Philadelphia, Pa.

Radium Therapy of Hemangiomata

The fact that hemangiomata occasionally disappear has led many physicians to defer treatment. Seventy per cent of these tumors enlarge shortly after birth; therefore treatment should be early, and thus save extension of the mass. Periodic growth. Portwine marks noticed at birth, rarely change in size and are not superficial. Pathologic difference, between the types, is responsible for variation of results from treatment. Comparison of the roentgen ray and radium. Complications during treatment. Difficulties encountered from previous forms of treatment, thickened scars, and keloids. Spontaneous ulceration, ulceration occurring during treatment. Complication from local lack of growth and function, deformity due to tumor, dermatitis, telangiectasis. Malignancy more likely in the pigmented variety. Treatment should be mild. Large masses upon the scalp should disappear and bald spots should be exceedingly rare. These tumors are usually more radiosensitive than hair. Discussion of treatment in the young infant, child and adult. Comparison with other types of treatment: surgery, electric modalities, caustics, injections of various solutions. General review of groups and individual cases, with emphasis upon bone changes observed in different types. Results observed immediately after treatment and ten to twenty years later. A plea for early treatment.

COURSE: 209

Room: C **Period: W-2**

G. E. PFAHLER, M.D. Philadelphia, Pa.

Radiation Treatment of Cancer of the Breast

The technique for the treatment of cancer of the breast cannot be standardized. The treatment will be demonstrated for cancer of the breast in various stages, including positioning of patient for treatment.

There will also be a demonstration of some of the cases treated primarily and completely by irradiation, also preoperative and postoperative irradiation, including the management of recurrences.

COURSE: 210

Room: C **Period: W-1**

WALTER C. POPP, M.D., Rochester, Minnesota

Roentgen Therapy for Inflammatory Conditions

A short introduction will be given covering the theories as well as the experimental work done by various workers, and the action of roentgen rays on infectious processes will be discussed. The selection of techniques for the treatment of both acute and chronic processes will be emphasized. The handling of acute infections with small dosages will be considered in some detail. Methods of treatment of a variety of common infections will be presented as individual entities. Statistical information will be shown indicating the experience in the treatment of acute sinusitis at the Mayo Clinic.

COURSE: 211

Room: F **Period: W-2**

GORDON E. RICHARDS, M.D., Toronto, Canada

Radiation Treatment of Oral Cancer

This discussion will deal with the treatment of cancer of the tongue, buccal mucosa, alveoli and soft and hard palate.

The greatest advance of the past ten years in the treatment of oral cancer has been a better understanding and more effective use of external and intraoral applications of roentgen rays combined with radium under certain conditions. In previous courses the subject of treatment of cancer of the tongue and buccal mucosa has been covered. In the present one the discussion is extended to include the alveoli, where the adoption of the methods outlined have resulted in a marked reduction of complications due to radionecrosis of bone, secondary infection as well as necrosis of soft tissue, resulting in slow healing and pain, most of which can be avoided by the adoption of methods of external irradiation. The course will be illustrated by colored lantern slides and graphic and statistical charts.

COURSE: 212

Room: J **Period: T-2**

ROBERT B. TAFT, M.D., Charleston, S. C.

Dosage Measurement from a Clinical Standpoint

The various methods in common use for measuring clinical roentgen-ray dosage will be discussed, and the advantages and disadvantages of each pointed out. The value of the roentgen as a clinical unit will be compared with formerly used units. Pros and cons

for the direct dosage measurement on the skin of the patient throughout the treatment time will be given. Air measurements versus skin measurements will be outlined and tables given for backscattering at commonly used wavelengths. Brief mention will be made of methods of determining stray radiation around a laboratory, either medical or industrial. Half of the period will be taken up with the above, and round table discussion will follow. Throughout, an earnest effort will be made to keep the matter within the scope of the clinical radiologist who has little knowledge of, or interest in, pure physical measurements. The instructor, having had experience in both clinical and physical work, will attempt to narrow the far-too-wide gap between the clinician and physicist.

COURSE: 213

Room: A **Periods: T-2; W-2**

B. P. WIDMANN, M.D., Philadelphia, Pa.

Radiation Therapy in Cancer of the Skin

Technical procedures for the radium and roentgen treatment of cancer of the skin will be reviewed and analyzed in detail. A definite predetermined plan of dosage has been formulated according to the estimated surface area and thickness of the lesion. Special emphasis will be placed on the value of low voltage roentgen rays (100–135 kv.), and a clinical comparison with radium will be made according to a great variety of patterns for single and multiple radium tubes with different sizes of fields, filters and distances. Conclusions will be drawn from a large clinical experience with massive and fractional doses. Determinations of the "maximum safe dose," the "minimal effective dose," the daily intensity and the probably best rate of administration will be considered with specific recommendations after a routine experience demonstrating results and skin tolerance.

DIAGNOSTIC ROENTGENOLOGY

COURSE: 301

Room: F **Period: W-1**

PAUL A. BISHOP, M.D., Philadelphia, Pa.

Examination and Diagnosis of Lesions of the Temporomandibular Joint

The frequency with which injuries of the temporomandibular joint are overlooked, both clinically and roentgenographically, has led to an appalling number of permanent, serious disabilities of the mandible. A technique for the roentgenographic study of this joint is presented with lantern slide demonstration of acute and chronic injuries, as well as various non-traumatic conditions.

COURSE: 302

Room: F **Period: Th-1**

PAUL A. BISHOP, M.D., Philadelphia, Pa.

A Classification of Fractures of the Ankle Based on the Mechanisms That Cause Them (Ashhurst and Bromer)

The use of "names" of fractures of the ankle is the cause of much confusion. "Pott's fracture" has been so popularized that, although it is a relatively infrequent fracture, it is the favorite clinical diagnosis in accident wards even in cases showing inward displacement, the opposite of a true Pott's fracture.

In 1922 Ashhurst and Bromer published a classification based on the mechanisms which cause the fractures, the characteristics of each being easily identified on roentgenograms. Thus, we are able to associate the various fractures produced by each acting force and separate those which, though similar anatomically, are caused by different forces.

It is a classification that justifies itself, and without classification "the relation of one lesion to another can be neither remembered nor understood in any department of knowledge; and comprehension is a prerequisite for intelligent memory and for rational diagnosis and treatment.

Lantern slide demonstration.

COURSE: 303

Room: C **Period: T-2**

FRANKLIN B. BOGART, M.D., Chattanooga, Tennessee

Leukosarcoma

The literature will be briefly reviewed and cases will be presented which illustrate the typical Sternberg syndrome with mediastinal tumor and other variations of borderline cases which present some features of lymphosarcoma and some features of leukemia.

COURSE: 304

Room: G **Periods: W-2; Th-2**

RALPH S. BROMER, M.D., Philadelphia, Pa.

The Differential Diagnosis of Skeletal Changes Occurring in Diseases of Infants and Children

The time allotted will be spent in discussing the differential roentgen diagnosis of skeletal changes occurring in diseases of infancy and childhood. All such diseases cannot be included in the time available for the course. Case material will be chosen from the following list: congenital syphilis, rickets, infantile scurvy, tuberculosis, lead poisoning, the blood dyscrasias, xanthomatosis and allied conditions, osteogenesis imperfecta, achondroplasia, mul-

tiple enchondromata, multiple cartilaginous exostoses, metastases caused by neuroblastoma, osteochrondritis and endocrine disturbances. Wherever possible the early roentgen changes will be emphasized. The question of differential diagnosis will be approached from the standpoint of the predisposition of the various diseases to affect certain bones or certain areas of individual bones. Thus in the case of the long bones, differential roentgen signs of the disease processes in the epiphysis, the diaphysis, the metaphysis, the periosteum, cortex, etc., will be given in detail.

COURSE: 305

Room: B **Period: T-2**

JAMES T. CASE, M.D., Chicago, Ill.

The Roentgenologic Diagnosis of Carcinoma of the Colon

In the diagnosis of carcinoma of the colon the pathological and anatomical considerations vary according to the location of the tumor in the right or left half of the colon. In colonic polyposis the symptomatology, like the pathology, varies with the position of the tumor in the right or left colon. Special technique is a matter of utmost importance. Repetition of the examination is often necessary.

The technique of examination for and the roentgenologic manifestations of cancer of the colon will be discussed and illustrated.

COURSE: 306

Room: B **Period W-1**

W. EDWARD CHAMBERLAIN, M.D., Philadelphia, Pa.

Technique and Interpretation of Air Myelography

Air has now been used successfully in hundreds of cases as the contrast medium for myelography. It has many advantages over other media but the roentgenographic requirements are very exacting.

Lumbar puncture vs. cisternal puncture for introduction of the air; methods of increasing scope of lumbar puncture route; adaptation of ordinary conventional roentgenographic apparatus to this work; essential factors in technique; stereoscopy essential in lateral as well as dorsal projections; stereoscopic shift across long axis of spine; value of comparing lateral projections with spine in hyperflexion and hyperextension; value of "over-exposing" films; oblique projections of little value except in cervical and upper thoracic regions; suggestions for after-care of patients.

COURSE: 307

Room: C **Period: Th-1**

ARTHUR E. CHILDE, M.D., Toronto, Canada

The Normal Encephalogram and Ventriculogram Congenital Abnormalities of the Brain

The roentgen technique of cerebral pneumography will be discussed and the importance of a few simple manipulations of the head during this procedure will be explained. This will be followed by a review of the normal anatomy of the ventricular system, basal cisterns and cortical markings. The pneumographic features of various congenital abnormalities will be shown.

COURSE: 308

Room: C **Period: F-1**

ARTHUR E. CHILDE, M.D., Toronto, Canada

The Pneumographic Diagnosis of Expanding, Contracting and Atrophic Intracranial Lesions

The deformities produced by various types of expanding intracranial lesions will be shown. Encephalography is often used to determine the cause of epileptic seizures in patients who do not suffer from brain tumors, and some examples of atrophic and contracting intracranial lesions will also be illustrated.

COURSE: 309

Room: G **Period: F-1**

ARTHUR C. CHRISTIE, M.D., Washington, D. C.

The Diagnosis and Treatment of Bronchiectasis

History and Incidence.

Etiology and Pathogenesis.

Diagnosis.

Symptoms and signs. Necessity and means of early diagnosis. Iodized oils. Instillation of iodized oil by the passive method. Description of method. Illustrative slides to show different types of bronchiectasis and conditions which may require differential diagnosis.

Treatment.

Necessity for treating complicating inflammatory conditions. Medication. Postural drainage. Iodized oils. Bronchoscopic drainage.

Surgery: Applicability and limitations. Artificial pneumothorax. Phrenicectomy. Pneumectomy.

Roentgen therapy: Rational basis for such treatment. Detailed descriptions of application, dosage, etc. Results illustrated by report of cases.

The aim of this course is to give a complete view of the diagnosis and treatment of this exceedingly

common disease in which the radiologist can play an important rôle in both fields.

COURSE: 310

Room: A Period: Th-1

LEWIS GREGORY COLE, M.D.
White Plains, N. Y.

Pulmonary Tubercles, Their Etiology, Pathogenesis, and Roentgen Shadows They Cast

These subjects will be considered in their reverse order, first showing roentgenograms of pulmonary tubercles, then demonstrating the pathological findings of various tubercles, illustrated with Kodochrome photomicrographs, and subsequently presenting their pathogenesis and etiology. This reverse manner of presenting the subject should appeal to roentgenologists more than the rational sequence in the reverse order.

COURSE: 311

Room: G Period: T-2

PEDRO L. FARIÑAS, M.D., Havana, Cuba

Bronchographic Examination in Primary Carcinoma of the Lungs

Bronchographic technique:

Simple bronchography (examination of the trachea and bronchi without contrast media).

Regular bronchography (examination of the trachae and bronchi with an opaque substance).

Mucosography (examination of the tracheobronchial mucosa coated with a very thin opaque layer).

Bronchographic aspects of the infiltrating and polypoid types of tumors.

Comparison between the bronchographic alterations and the anatomical specimen in the different types of bronchial tumors.

COURSE: 312

Room: B Period: T-1

JOHN T. FARRELL, JR., M.D.,
Philadelphia, Pa.

Roentgen Diagnosis of Lesions of the Esophagus

The technique of roentgen examination of the esophagus with liquids, semi-solids, and solids, together with the indications and limitations of each, will first be presented. This will be followed by consideration of the roentgen anatomy and physiology. Study of pathological states will embrace the diagnosis and differential diagnosis of congenital, inflammatory, traumatic, functional, and neoplastic conditions of the organ.

COURSE: 313

Room: J Periods: W-2; Th-2

C. A. GOOD, M.D., Rochester, Minnesota

The Small Intestine

All of the lesions commonly encountered in the small intestine will be discussed. Special emphasis will be placed upon the diagnosis of the organic lesions which are amenable to surgical treatment, such as enteritis, Meckel's diverticulum and benign and malignant tumors.

Particular attention will be paid to the roentgenoscopic method of examination and there will be a brief consideration of the clinical indications for a roentgenologic examination of the small intestine.

Lantern slides of roentgenograms and of colored photographs of the pathologic material will be presented.

COURSE: 314

Room: A Period: W-1

GEORGE W. GRIER, M.D., Pittsburgh, Pa.

The Diagnosis of Congenital Heart Lesions in Children

Various malformations and congenital lesions of the heart will be discussed. Lesions which produce characteristic changes will be presented, as well as combinations of lesions. Other lesions in which the roentgen findings and clinical evidence combined will make a diagnosis will also be discussed. Films of a number of cases that have come to autopsy will be presented.

COURSE: 315

Room: H Period: Th-2

A. O. HAMPTON, M.D., Washington, D. C.

The Roentgenologic Diagnosis of Pulmonary Infarction and Bronchial Occlusion; Technique and Interpretation of Venograms and their Importance in Prevention of Fatal Pulmonary Embolism

This discussion will include:

1. The appearance of bronchial occlusion in the lateral view of the chest.
2. The roentgen diagnosis of pulmonary infarction with special reference to the indications for venograms.
3. A few remarks on the technique and interpretation of venograms.
4. The importance of the roentgen examination of the chest and deep veins of the legs in the prevention of fatal pulmonary embolism.

COURSE: 316

Room: B **Periods: Th-1; F-1**

HUGH F. HARE, M.D., Boston, Mass.

Myelography

Myelography may be useful when performed with either oxygen, iodized oil (lipiodol) or pantopaque. It may be diagnostic or may be used as an aid to diagnosis.

The period will be devoted to a discussion of the various methods of myelography and their relative values in diagnosis.

COURSE: 317

Room: I **Periods: T-1; W-1**

HERMAN HILLEBOE, M.D.,
U. S. Public Health Service
RUSSELL H. MORGAN, M.D., Chicago, Ill.

Mass Roentgenography of the Chest

The development of mass roentgenography of the chest within the last decade has introduced a number of problems to the radiologist in the fields of diagnosis and technique. These problems will be discussed in detail. In addition, consideration will also be given to the planning and organization of mass roentgenographic programs in hospitals and in industry. Those taking the course will be asked to participate in the discussions and to present questions during the progress of the presentation.

COURSE: 318

Room: I **Period: T-2**

F. J. HODGES, M.D., Ann Arbor, Mich.

Nontuberculous Lesions of the Chest

In studying roentgenograms of the chest the likelihood of encountering some form of tuberculosis must always be considered. While it is not possible in all instances to eliminate tuberculosis as the primary cause of many intrathoracic abnormalities, a considerable number of intrathoracic conditions do provide tangible roentgenologic signs which lead to their positive identification. Even when positive diagnosis cannot be made, careful analysis of roentgenograms can provide diagnostic information of great value. Accordingly, in this course nontuberculous lesions presenting recognizable roentgenologic signs will be outlined, discussed and demonstrated with examples.

COURSE: 319

Room: B **Period: W-2**

E. L. JENKINSON, M.D., Chicago, Ill.

Diaphragmatic Lesions Producing Gastrointestinal and Bizarre Cardiac Symptoms

Congenital short esophagus and its differentiation from diaphragmatic hernia will be covered. The frequency of hiatal hernia (para-esophageal) will be considered. The importance of the hernia as to the symptoms it may cause will also be discussed. The identification of a hernia is often of paramount importance in ruling out a suspected cardiac lesion. Pain referable to the precordium is often caused by a hernia and it is by no means essential that the hernia be very large. Lesions of the diaphragm will be classified as follows:

1. Congenital short esophagus
2. Para-esophageal hernia
3. Evisceration
4. Absence of the diaphragm
5. Thoracic stomach
6. Eventration

COURSE: 320

Room: I **Period: W-2**

A. S. MACMILLAN, M.D., Boston, Mass.

Roentgen Examination of the Accessory Nasal Sinuses

The technique of examination of the patient for suspected sinus disease will be considered. Particular stress will be placed upon four positions which the instructor considers the irreducible minimum in the examination of the sinuses.

Acute and chronic sinusitis, the sinus involvement in allergy and in malignant disease as well as the cause of exophthalmus in sinus involvement.

There is a great deal of discussion among otolaryngologists as to the value of the roentgen ray as an aid in the diagnosis. An attempt will be made to talk about the practical points in interpretation.

COURSE: 321

Room: I **Period: Th-2**

A. S. MACMILLAN, M.D., Boston, Mass.

Roentgen Examination of the Mastoids

The technique of the examination of the patient for mastoid involvement in acute infections of the middle ear will be considered. Demonstrations of the various positions for the examination of the petrous pyramid in the search for involvement of this area as a complication of infection and invasions by new growths of the base of the skull and nasopharynx.

He will consider the rôle played by the roentgen ray in the determining of the optimum time for operation, the limitations of this type of examination

and the need for the roentgenologist to acquaint himself with the problems of the surgeon.

COURSE: 322

Room: C **Period: Th-2**

L. G. RIGLER, M.D., Minneapolis, Minn.

Bronchial Obstruction

1. Bronchial obstruction is such an important factor in the production of pulmonary disease processes that a thorough understanding of its nature and effects is necessary.

2. The manifestations of bronchial obstruction tend to be uniform, regardless of the cause; that is, similar roentgenologic findings may be observed in such widely divergent processes as foreign bodies, asthma and lung tumors.

3. The changing diameter of the lumen of the trachea and bronchi during inspiration and expiration results in the production of two apparently opposite phenomena—emphysema and atelectasis—from the same obstructing mechanism.

4. A transition from obstructive emphysema to obstructive atelectasis, to bronchiectasis or to lung abscess may occur as a result of any type of obstruction, depending upon the nature, location and degree of the occlusion, the rapidity of its occurrence, and other incidental factors.

5. The roentgen examination of patients suspected of bronchial obstruction should include some or all of the following procedures: (1) fluoroscopy; (2) roentgenography in various positions and phases of respiration; (3) body section roentgenography; (4) bronchography.

6. Exact localization and determination of the nature of the bronchostenosis are important in order to permit proper surgical approach. Careful roentgen examination when added to the various other procedures, such as physical examination, bronchoscopy, and sputum examination should accurately delineate the nature, location, extent and effects of any type of bronchial obstruction.

7. An exposition of the roentgen findings in bronchial obstruction by means of slides and diagrams will be given.

COURSE: 323

Room: J **Period: F-1**

SAMUEL A. ROBINS, M.D., Boston, Mass.

Utero-salpinography

This course concerns itself with the roentgen examination of the uterus and tubes by means of opaque media. The subject will be discussed under the following headings: (1) history; (2) apparatus and technique; (3) opaque media; (4) indications; (5) normal morphology; (6) physiologic variations; (7) pathologic variations; (8) pregnancy; (9) tumors (fibroids, polypi, malignancy); (10) inflammatory changes of the tubes; (11) tubal pregnancy; (12) sterility; (13) post-therapeutic changes in the uterus; (14) contraindications; (15) dangers.

Lantern slides of various physiologic and pathologic conditions of the uterus and tubes will be shown to evaluate this method of examination.

COURSE: 324

Room: A **Period: T-1**

L. R. SANTE, M.D., St. Louis, Mo.

Atypical Pneumonias

Their place in the roentgenological group of pneumonias.

Their roentgenological differentiation from other types of pneumonic involvement.

Their pathological variation from other types of pneumonia.

COURSE: 325

Room: I **Periods: Th-1; F-1**

RICHARD SCHATZKI, M.D., Boston, Mass.

Small Bowel Enema

1. Technique of examining the small intestine with the help of the small bowel enema will be described.

2. Indications and contraindications will be discussed.

3. The method will be compared with other methods of examining the small bowel.

4. Practical examples will illustrate the discussion.

COURSE: 326

Room: H **Period: T-2**

CARLOS H. SCHOTT, D.D.S., Cincinnati, Ohio
EDWARD L. BALL, D.D.S., Cincinnati, Ohio

Radiodontic Interpretation

Operating Room Procedure	Anatomic landmarks
	Positioning of the patient
	Placement and retention of film
	Angulation
	Exposing
	Mounting
	Economics
Interpretation	Children's dentistry
	Operative dentistry
	Periodontia
	Exodontia and oral surgery
	Prosthodontia and crown and bridge
	Orthodontia

COURSE: 327

Room: H **Period: W-2**

HARRY M. WEBER, M.D., Rochester, Minn.

Chronic Ulcerative Colitis and Allied Intestinal Disorders

The name "chronic ulcerative colitis" may validly be applied to any non-neoplastic pathologic process in the large intestine in which inflammatory changes are predominant. In a restricted sense, however, the name denotes a specific disease entity, the etiology of which is still not established with certainty, but which has distinctive pathologic features. These characteristic pathologic characteristics are observed directly at proctosigmoidoscopic examination, and are reflected in the roentgenologic changes observed with the disease. These roentgenologic manifestations will be described and correlated with those of other etiologic types or more or less diffuse inflammatory processes commonly encountered in the colon. Emphasis will be on roentgenologic aspects, but the proctosigmoidoscopic manifestations will be demonstrated with a motion picture in color prepared by Dr. L. A. Buie and his associates in the Section on Proctology, Mayo Clinic.

COURSE: 328

Room: J **Periods: T-1; W-1**

GEORGE M. WYATT, M.D., Washington, D. C.
W. S. RANDALL, M.D., Washington, D. C.

Benign and Malignant Lesions of Bone

This material is selected from the cases admitted to the Walter Reed General Hospital in its capacity as a tumor center during World War II. Lantern slides include the roentgenographic, gross, and microscopic appearance of the various lesions.

Among the conditions to be considered are osteomyelitis, osteoid osteoma, fibrous dysplasia, eosinophilic granuloma, giant cell tumor, lymphoma, chondrosarcoma, osteogenic sarcoma, Ewing's tumor, neuroblastoma, and myeloma.

Attention will be directed to correlation of the roentgen appearance and gross pathology and to differential diagnosis of benign and malignant lesions.

COURSE: 329

Room: C **Period: T-1**

BARTON R. YOUNG, M.D., Philadelphia, Pa.

Roentgen Diagnosis of Diseases of the Air and Food Passages of the Neck; Planigraphy of the Larynx

The normal roentgen anatomy of the soft tissues of the air and food passages is reviewed in detail in the first part of the course. Roentgenoscopy is an indispensable preliminary procedure, so considerable time is devoted to a discussion of this part of the examination. The disturbances in deglutition due to tumor, infection or faulty innervation and the altered physiology and morphology of the larynx that result from any one of these conditions are readily detected by roentgenoscopic examination, and the roentgenoscopic appearances of some of the more common lesions are shown.

The changes in the air and food passages produced by foreign bodies and inflammatory and neoplastic diseases are demonstrated by exhibiting non-planigraphic and planigraphic roentgenograms. A technique for obtaining posteroanterior studies using non-planigraphic methods is outlined, and the value of this procedure for lateralizing laryngeal lesions is emphasized by showing illustrative cases.

The indications for body section roentgenography, and the results obtained from the application to the neck are presented. Planigraphy is of maximum value in the demonstration of tumors of the larynx but its superiority to conventional roentgen methods is not limited to the larynx. The planigraphic appearance of a number of interesting lesions in the larynx and cervical trachea is shown and discussed.

Section on Instruction

ORDER SHEET

It is important to register for the Instruction Courses as early as possible since the number admitted to each course will be limited. *It is also very important that you list your first, second and third choice for each period.* All orders for tickets will be filled according to postmark on envelope.

Non-members, except full time graduate students in Radiology, will pay $1.00 for each course-period or a maximum of $5.00 for five or more such periods. *Non-members' fees must accompany this order sheet* and will not be returned unless cancellation is received before September 14, 1946.

Fill out the following (type or print):

Check ☐ Member ☐ Guest ☐ Graduate Student in Radiology at:

....
Last Name First Name or Initials

.....
Street Address

....
City State

For convenience in selecting your courses, consult the condensed schedule on the following pages.

CLAIMING INSTRUCTION COURSE TICKETS

Beginning Monday, September 16 those who have sent in advance orders may secure their tickets at the Registration Desk located in the foyer on the Fourth Floor of the Netherland Plaza Hotel. Tickets may also be secured for courses not filled.

Please remember that the Sequential Courses are continuous courses and run from two to four periods. *No part of them is repeated.* They are numbered A to D. All other courses are single-period courses and a few are repeated

BE SURE TO FILL OUT SECOND AND THIRD CHOICES FOR EACH PERIOD

Period		First Choice		Second Choice		Third Choice	
		Course No.	Instructor	Course No.	Instructor	Course No.	Instructor
Tuesday	1						
	2						
Wednesday	1						
	2						
Thursday	1						
	2						
Friday	1						

Previous to September 7, 1946, send this order sheet to:
B. R. KIRKLIN, M.D., Mayo Clinic, Rochester, Minnesota.

After September 7, 1946, mail to:
B. R. KIRKLIN, M.D., American Roentgen Ray Society, Netherland Plaza Hotel, Cincinnati 2, Ohio.

CONDENSED SCHEDULE OF COURSES ON TUESDAY

Code: T-1 **1st PERIOD—8:00 to 9:15** **Code: T-1**

Sequential Courses, Physics and Therapeutic Radiology		Diagnostic Roentgenology	
B—Golden	Roentgenology of the Small Intestine	**312—Farrell**	Roentgen Diagnosis of Lesions of the Esophagus
C—Wasson	Anatomy of the Lungs	**317—Hilleboe Morgan**	Mass Roentgenography of the Chest
101—Braestrup	Common Causes of Radiation Hazards in Roentgenology	**324—Sante**	Atypical Pneumonias
202—Fricke	Radium Therapy in Nonmalignant Conditions	**328—Wyatt Randall**	Benign and Malignant Lesions of Bone
207—Martin	Radiation Treatment of Cancer of Lip and Mouth	**329—Young**	Diagnosis of Diseases of the Air and Food Passages of the Neck. Planigraphy of the Larynx

Code: T-2 **2nd PERIOD—9:30 to 10:45** **Code: T-2**

Physics and Therapeutic Radiology		Diagnostic Roentgenology	
104—Henny	Roentgen-Ray Film Characteristics and Calibration of Apparatus and Processing Solutions	**303—Bogart**	Leukosarcoma
108—Williams	Roentgen-Ray Circuits and Apparatus	**305—Case**	Roentgenologic Diagnosis of Cancer of the Colon
208—Newcomet	Radium Therapy of Hemangiomata	**311—Fariñas**	Bronchographic Diagnosis of Bronchogenic Carcinoma
212—Taft	Dosage Measurement from a Clinical Standpoint	**318—Hodges**	Nontuberculous Lesions of the Chest
213—Widmann	Radiation Therapy in Cancer of the Skin	**326—Schott Ball**	Radiodontic Interpretation

CONDENSED SCHEDULE OF COURSES ON WEDNESDAY

Code: W-1 — **1st PERIOD—8:00 to 9:15** — **Code: W-1**

Sequential Courses, Physics and Therapeutc Radiology		Diagnostic Roentgenology	
B—Golden	Roentgenology of the Small Intestine	**301—Bishop**	Lesions of the Temporomandibular Joint
C—Wasson	Physiology and Mechanics of the Chest and Lungs	**306—Chamberlain**	Technique and Interpretation of Air Myelography
102—Failla	Dosage Problems in the use of Radioactive Isotopes	**314—Grier**	Diagnosis of Congenital Heart Lesions in Children
207—Martin	Radiation Treatment of Cancer of Lip and Mouth	**317—Hilleboe Morgan**	Mass Roentgenography of the Chest
210—Popp	Roentgen Therapy of Inflammatory Conditions	**328—Wyatt Randall**	Benign and Malignant Lesions of Bone

Code: W-2 — **2nd PERIOD—9:30 to 10:45** — **Code: W-2**

Physics and Therapeutic Radiology		Diagnostic Roentgenology	
103—Glasser	Atomic Energy in Radiology	**304—Bromer**	Differential Diagnosis of Skeletal Changes in Diseases of Children
204—Kerr	Irradiation of Malignant Tumors of the Pelvis	**313—Good**	The Small Intestine
209—Pfahler	Radiation Treatment of Cancer of the Breast	**319—Jenkinson**	Diaphragmatic Lesions
211—Richards	Radiation Treatment of Oral Cancer	**320—Macmillan**	Roentgen Examination of Accessory Nasal Sinuses
213—Widmann	Radiation Therapy in Cancer of the Skin	**327—Weber**	Chronic Ulcerative Colitis and Allied Intestinal Disorders

CONDENSED SCHEDULE OF COURSES ON THURSDAY

Code: Th-1 **1st PERIOD—8:00 to 9:15** **Code: Th-1**

Sequential Courses, Physics and Therapeutic Radiology		Diagnostic Roentgenology	
B—Golden	Roentgenology of the Small Intestine	**302—Bishop**	Fracture of the Ankle: Classification
C—Wasson	Classification of Diseases of the Lungs	**307—Childe**	Normal Encephalogram and Ventriculogram
106—Taylor	Ionization Chambers and Their Uses	**310—Cole**	Pulmonary Tubercles: Etiology, Pathogenesis, Their Roentgen Shadows
201—Ernst	Radiation Treatment of Cancer of the Cervix	**316—Hare**	Myelography
203—Friedman	Supervoltage Roentgen Therapy	**325—Schatzki**	Small Bowel Enema: Technique and Interpretation

Code: Th-2 **2nd PERIOD—9:30 to 10:45** **Code: Th-2**

Sequential Courses, Physics and Therapeutic Radiology		Diagnostic Roentgenology	
A—Donaldson	Radiologic Jurisprudence	**304—Bromer**	Differential Diagnosis of Skeletal Changes in Diseases of Children
D—Capurro	Topographic Roentgen-Ray Diagnosis of Tumors of Abdomen	**313—Good**	The Small Intestine
105—Quimby	Dosage Calculation in Radium Therapy	**315—Hampton**	Roentgen Diagnosis of Pulmonary Infarction and Bronchial Occlusion
205—Lenz	Roentgen Therapy of Lymphosarcoma	**321—Macmillan**	Roentgen Examination of the Mastoids
206—Leucutia	Radiation Therapy in Tumor of Bone	**322—Rigler**	Bronchial Obstruction

CONDENSED SCHEDULE OF COURSES ON FRIDAY

Code: F-1 **1st PERIOD—8:00 to 9:15** **Code: F-1**

Sequential Courses, Physics and Therapeutic Radiology		Diagnostic Roentgenology	
A—Donaldson	Radiologic Jurisprudence	**308—Childe**	Pneumographic Diagnosis of Expanding, Contracting and Atrophic Intracranial Lesions
C—Wasson	Roentgenologic Diagnosis Diseases of the Lungs	**309—Christie**	Diagnosis and Treatment of Bronchiectasis
D—Capurro	Topographic Roentgen-Ray Diagnosis of Tumors of the Abdomen	**316—Hare**	Myelography
107—Weatherwax	Dosage Calculations in Roentgen Therapy	**323—Robins**	Uterosalpingography
203—Friedman	Supervoltage Roentgen Therapy	**325—Schatzki**	Small Bowel Enema: Technique and Interpretation

DR. CHAMBERLAIN TAKES PART IN WESTINGHOUSE CENTENNIAL FORUM

Dr. W. Edward Chamberlain, Director of the Department of Radiology, Temple University Hospital and Professor of Radiology of Temple University, and a member of the American Roentgen Ray Society since 1922, took part in the program of the George Westinghouse Centennial Forum held in Pittsburgh May 16, 17 and 18, 1946. This Forum was attended and participated in by the greatest scientific minds of this and other nations. The subject of the afternoon session of the first day of the Forum was "The Future of Atomic Energy." The speakers included Dr. Enrico Fermi who in 1938 won the Nobel Prize for his work on bombardment of the atom; Dr. J. Robert Oppenheimer, who planned, organized and directed the special atom laboratory at Los Alamos, New Mexico; Dr. Hugh S. Taylor, Dean of the Graduate School, Princeton University, who played a prominent part in mobilizing science during World War II, and Dr. Chamberlain. The biological phase of atomic energy was discussed by Dr. Chamberlain. His conclusion was that the new science of atomic energy will benefit biology and medicine not only directly, as when radioactive isotopes from cyclotron, betatron or chain-reaction-pile are put to work as tracers, or as therapeutic agents, but indirectly, through the spectacular advances which it has produced and will continue to produce in all scientific thinking. Each of the participants in the program of the Forum received the George Westinghouse Medal.

DR. FEDOR HAENISCH

Hamburg is in the British zone of German occupation and there is as yet no direct mail communication with the United States. It was learned that Dr. Fedor Haenisch, since 1907 an honorary member of the American Roentgen Ray Society, had been ill, and that his roentgen department in the Barmbeck Hospital in Hamburg was a casualty of the war. One report was brought back from overseas by an American medical officer that Dr. Haenisch had died. This report led to his being included in the 1946 membership directory of the American Roentgen Ray Society as deceased. Dr. Haenisch's many friends in America will be glad to know that authentic news has been received, through roundabout but reliable channels, that he is still alive. The date of this information is May 27, 1946.

Dr. Haenisch is well known in the United States and has made numerous visits here, the last one being at the time of the Fifth International Congress of Radiology held in Chicago in 1937. In 1931 he delivered the Caldwell Lecture at the Atlantic City meeting of the American Roentgen Ray Society when Dr. Leopold Jaches was president. The topic was "Roentgenology as a Specialty." He discussed aspects of the relationships of roentgenology as of 1931 in Germany, which are of even more interest in the United States at present than they were then. This lecture was published in this JOURNAL in December, 1931.

RAMSAY SPILLMAN

DR. STONE RECEIVES MEDAL OF MERIT

Dr. Robert S. Stone has received from President Truman the Medal of Merit of the United States for his work on the "Manhattan Project" at Oak Ridge during World War II.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

SKELETAL SYSTEM

Anderson, Roger, and O'Neil, Gordon. Comminuted fractures of the distal end of the radius. *Surg., Gynec. & Obst.*, April, 1944, *78*, 434–440.

The need of change in the methods of treating comminuted fractures of the distal end of the radius is evident from an evaluation of the average end-results, expressed by the patients as weakness, stiffness, soreness and deformity. Roentgenographic studies a year after the accident will, in a high percentage of cases, reveal a shortened radius, maltilted articular face, depressed or irregular joint surface, and a relative enlargement of the ulnar styloid.

The authors' clinical studies have demonstrated that these undesirable sequelae can be minimized by the use of protracted traction. Success calls for a prolonging of traction until consolidation is complete. While reduction with restoration of radial length is usually not too difficult to obtain, it is difficult to maintain because the intact ulnar shaft acts as a pivoting point for the contracting strong radial muscles.

The original shortening in many of these wrists fractures is due not altogether to overriding or telescoping of the many fragments but to an actual crushing of the cancellous bone. In these cases an apparent end-to-end reduction will not suffice because the articular fragment must be pulled out into its normal relationship with the ulna. Furthermore, it must be held in this extended position over a long period of time (eight to twelve weeks) awaiting not only the filling in but the aging of the cancellous bone to a degree sufficient to withstand the compressing force of the muscles.

All the anatomic and functional benefits of a satisfactory reduction sustained through traction until consolidation is complete, without fear of joint stiffness, are now possible with a new technique. The basic principles of this procedure are reduction obtained through skeletal traction in conjunction with skeletal half-pin countertraction, and immobilization by use of two slender rods instead of a cast. The technique of applying the apparatus is described in detail.—*Mary Frances Vastine.*

Siris, Irwin E., and Ryan, John D. Fractures of the neck of the femur; analysis of 157 intracapsular and extracapsular fractures. *Surg., Gynec. & Obst.*, June, 1944, *78*, 631–639.

This study analyzes the treatment of 157 consecutive fractures of the neck and intertrochanteric region of the femur seen on the Fracture Service of the Third (New York University) Division of Bellevue Hospital from January 1, 1941, to June 30, 1943. It is the authors' contention that immediate internal fixation enhances the ability of feeble, undernourished patients to survive, permits their ambulation in bed, reduces the incidence of potential complications, and allows early ambulation with crutches.

The following observations are included in the conclusions:

1. The treatment of choice for the intracapsular fractures in the aged and feeble is the immediate insertion of a Smith-Petersen cannulated 3-flanged nail or similar device.

2. The treatment of choice for the intertrochanteric fractures in the aged is the immediate insertion of a device incorporating the principle of a Smith-Petersen nail and Hawley bar, preferably a Moore-Blount blade plate.

3. For intertrochanteric fractures in the younger age group, bilateral Russell traction suspension has given very satisfactory results.

4. External pin fixation should not replace internal fixation for fractures of the hip or intertrochanteric region. Other than expediting the procedure of transfixion and minimizing the immediate trauma, it has none of the advantages of internal fixation. It is an extremely hazardous procedure and should be restricted to those who have had experience and are familiar with its technique.

5. It would seem that the patients who are in poor physical condition on admission have a better chance of survival if they are operated upon immediately rather than waiting to see if their general condition improves.

6. The use of local anesthesia, focal skin clips, and guide wires, and the three sets of indispensable roentgenograms, to determine (1) the accuracy of reduction and location of the skin clip in relation to the head of the femur, (2) the position of the guide wires, and (3) the position of the nail, will enhance the ability of the surgeon to expedite the proper insertion of the transfixion device.—*Mary Frances Vastine.*

Proctor, Samuel E., Campbell, Thomas A., and Dobelle, Martin. March fractures of the tibia and femur. *Surg., Gynec. & Obst.*, April, 1944, *78*, 415–418.

In this report, the authors discuss 7 tibial march fractures and 1 femoral march fracture encountered in three month period at the Station Hospital, Camp Reynolds, Greenville, Pennsylvania. This series includes the fourth reported case of an identical bilateral march fracture of the tibiae.

Differential Diagnosis. (1) Garré's sclerosing osteomyelitis; (2) periostitis; (3) osteogenic sarcoma or Ewing's sarcoma; (4) bone syphilis; (5) tuberculosis of bone.

Significant Findings in the 7 Cases of March Fracture.

1. Body type and age incidence. Patient was usually of the tall, fair Nordic type. The age average was nineteen years, eight months.

2. Mode of onset. In every instance there was sudden pain in the upper tibia followed by lameness. These symptoms always occurred during exercise such as sustained marching, double timing or obstacle course running.

3. Laboratory findings. The serum phosphatase was within the upper limits of normal. The serum calcium was consistently low and the serum phosphorus slightly elevated.

4. Roentgenological aspects . . . 4 stages are described:

Stage 1. Time: Seen in the first week following the sustained march fracture. A fine horizontal fracture line is seen through the upper shaft of the tibia, about 10 cm. from the knee joint.

Stage 2. Time: Seen in the second week following the sustained march fracture. A very slight amount of callus is seen at the medioposterior cortical fracture site. The callus is first seen in this position because it is the point of greatest weight-bearing stress. The fibula splints the lateral fracture site which probably accounts for the lack of callus at this point.

Stage 3. Time: Seen in the third week following the sustained march fracture. A band of bone condensation is seen at the fracture site and bone absorption at immediate fracture line. Parallel cortical callus is present at medioposterior cortical fracture site. Callus is sometimes seen at the lateral fracture site during this stage.

Stage 4. Time: Seen in the fourth week up to the twelvth week following the sustained march fracture. Cortical callus and bone condensation are increasing. Fracture line has disappeared. After the twelfth week the callus begins to absorb.

Mechanics of March Fracture Formation. A rhythmical mechanical stress at the point of greatest bone bending is the salient factor in the production of this type of fracture. The rhythmical mechanical stress is the alternate thrust of the body weight down each leg during each step. The tibia and the femur are rhythmically bent anterolaterally with each step and the microtraumas occur at the sites of greatest bone bending (which was at the upper shaft of the tibia and the lower shaft of the femur in the cases discussed).—*Mary Frances Vastine.*

Bertram, D. R. "Stress" fracture of bone. *Brit. J. Radiol.*, Aug., 1944, *17*, 257–258.

Since the publication of an article on stress or fatigue fracture in February, 1943, a careful watch has been kept for roentgen evidence of such fractures in other bones than the metatarsals. The author works in a Naval hospital devoted chiefly to the treatment of orthopedic conditions and the fact that only 2 such cases have been seen in twelve months indicates the rarity of this condition in the long bones, at least in the Navy.

Both these patients were young men of eighteen. One had a stress fracture of the femur and the other one of both tibiae. The latter patient gave history of a stress fracture two years previous to entering the Navy. His occupation had been sedentary and he did not indulge in games or sports. Both cases began with pain in the affected region. Roentgenograms are given showing the typical picture of

stress fracture in both cases.—*Audrey G. Morgan.*

Allende, Guillermo, and Freytes, Manuel V. Luxación-fractura de Lisfranc. (Luxation fracture of Lisfranc's joint.) *Rev. ortop. y traumatol.*, July, 1944, *14*, 63–74.

Three cases of luxation of Lisfranc's joint are described and illustrated with roentgenograms. In addition to the dislocation, there were slight fractures of the bases of the metatarsals which is common. The anatomy of the joint is reviewed, showing that when a person falls on the tip of the foot the weight of the body is transmitted to the first metatarsal, which may resist, fracture or be dislocated. A classification of these dislocations is given. It has been held that they recover without treatment but the descriptions of the authors' cases, 2 of which came for treatment late, show that early treatment is advisable. It is generally possible to reduce the dislocation manually, but if not, operation may be performed, removing any troublesome projecting bones and performing arthrodesis. The authors believe that treatment with Cuendet's traction apparatus, which is illustrated, gives good results in most cases, though it does not correct the lateral deviation which occurred in one of their cases.—*Audrey G. Morgan.*

Voegelin, Adrian W., and McCall, Milton L. Some acquired bony abnormalities influencing the conduct of labor, with reports of recent cases. *Am. J. Obst. & Gynec.*, Sept., 1944, *48*, 361–370.

This study is concerned only with those pelvic abnormalities which have been acquired, due to either trauma, specific disease, or to neoplasms.

Trauma. Until the advent of fast motor travel in recent years, the incidence of pelvic fracture as a complication of labor was comparatively rare.

Eighty per cent of the cases of pelvic fracture have multiple fractures. Common sites are the rami of the pubis and ischium, and the alae of the ilium.

Fractures of the pelvis are usually the result of severe impact. Eighty per cent now occur in automobile accidents. The injury commonly occurs as the result of the passenger in the rear seat of an automobile being thrown forcibly against the side of the car.

From the obstetric standpoint, the lateral rushing fractures are the most important because greater distortion of the pelvic inlet is likely to result. Fracture of the descending ramus of the pubis may be of serious import because the outlet of the pelvis may be encroached upon. A severe fracture about the symphysis pubis with separation or displacement is dangerous because of the possibility of injury to the urethra or bladder upon descent of the presenting part.

After a few years have passed, some of the most severe cases of pelvic fracture are surprisingly free of excessive callus formation or severe pelvic deformity. Often nature helps to compensate for these deformities by bringing about premature labor or producing a small baby.

Dislocation of the joints due to trauma may cause concern. Dislocation of the head of the femur usually causes no marked pelvic deformity even though it be congenital. In bilateral subluxation, the heads of the femora may project into the pelvis through the sciatic notches when the patient is put in the normal abduction position for labor. Such a case may be delivered by abandoning the obstetric position and adducting the legs.

Forward displacements of the coccyx with ankylosis of the sacrococcygeal joint due to an old injury may cause dystocia at the pelvic outlet but it usually is not serious.

Specific Disease. These cases are uncommon; those due to bacteria, especially tuberculosis, are seen most frequently. Tuberculous coxitis when it occurs in early life nearly always causes an obliquely contracted pelvis. The distortion is usually on the healthy side. The diseased leg is shortened so that in walking the body weight is transmitted in great part to the well leg. This tends to flatten the iliopectineal line and the sacrum is rotated to some degree about its vertical axis, so that its anterior surface looks toward the well side. The pelvis is affected throughout from the inlet to the outlet.

A typical kyphotic pelvis (usually tuberculous in origin) is characterized by an elongated conjugata vera and a contracted outlet. This is brought about because the body weight transmitted to the lumbosacral hump is directed both downward and backward. The promontory of the sacrum is drawn backward and upward, the posterior extremities of the innominate bones are pushed apart and their lower portions inward. The lower portion of the sacrum is pushed forward. Thus, in a kyphotic pelvis the

distance between the iliac crests is equal to, or greater than, that between the two trochanters. The diagonal conjugate is deep. The biischial distance is small and also the posterior sagittal measurement.

In the authors' experience osteomyelitis of the pelvic bones has not caused severe pelvic dystocia. In cases of old poliomyelitis with unilateral lameness, there is sometimes a slight obliquity of the pelvis, but never as severe as in those cases in which the lameness is due to hip disease.

Neoplasms. Neoplasms of the spine ordinarily cause no difficulty in pregnancy unless they involve the sacrococcygeal region. Tumors of the pelvic girdle can, however, cause serious dystocia. Of the malignant tumors, 5 per cent of osteogenic sarcomas, which is a neoplasm of young people, occur in pelvic bones.

The benign neoplasms are the most common. These are usually bony exostoses which may be found over the iliopectineal eminences, the crests of the pubis, or over the pelvic joints. Like the enchondromas, which grow rapidly during pregnancy, they often cause serious obstruction to labor.—*Mary Frances Vastine.*

Jungmann, H. Osteochondritis of patella. *Brit. J. Radiol.*, Oct., 1944, *17*, 305–307.

In the majority of children the patella ossifies from one nucleus which appears on the roentgenogram at the age of from three to five years. In some cases secondary centers of ossification appear at puberty and these may become the site of osteochondritis. The secondary centers show blurred outlines but these appear on both sides though usually only one side is diseased clinically. This is called Sindig-Larsen-Johansson's disease from the authors who first described it.

Osteochondritis of the primary center is rarer and only a few cases have been described. Unlike osteochondritis of the secondary centers it is almost always unilateral. A case is described which was followed up for four years from its beginning to the healing stage. The patient, a boy of nine, first complained of pain and difficulty of movement of the left knee joint in July, 1939. Roentgenograms of both knees are given; the right normal one showed the normal size of the patella for that age. The left showed decrease in width and increase in length of the patella, apparently caused by the upper and lower poles being pulled apart. The outline was poorly defined, the structure was irregular and there were signs of sclerosis near the upper part of the patella. A roentgen diagnosis of osteochondritis was made but tuberculosis was suspected clinically and the patient was treated accordingly. In 1940 the roentgen appearance definitely ruled out tuberculosis. in 1943 the left patella was well outlined but sclerosis and small cyst-like areas of rarefaction were seen throughout it. A horizontal line dividing the upper from the lower part indicated that the bone had been fragmented and the fragments had later fused. At the posterior end of the line there was a small bony defect partly filled by two small separate pieces of bone. The roentgen appearances were the same as those described by other authors in this disease. Experimental work in the production of osteochondritis in the patella is described. Mau believes that the rarity of the disease in the patella is due to its abundant blood supply in spite of the fact that the strain on the patella is enormous and it is subjected to many injuries. —*Audrey G. Morgan.*

Brailsford, James F. The investigation of sciatica and lumbago—radiological aspect. *Brit. J. Radiol.*, Oct., 1944, *17*, 308–311; correction, Nov., 1944, *17*, 351.

The cause of low back pain is one of the much disputed questions in medicine. It has been attributed to a multitude of causes including maldevelopment and injury, inflammation or new-growth in the skeletal, nervous, gastrointestinal, vascular and genitourinary symptoms and because of the difficulty of determining a definite cause many physicians attribute it to hysteria. Certain clinicians advise against roentgenography because of the danger of increasing the hysterical element, but the author strongly advises roentgen examination as the causes, which are not uniform, may often be shown by such examination. It may show trauma of the lumbosacral region; there may be no roentgen changes in the first few weeks but later reactive changes are seen. Irregularities in the development of the lumbosacral elements are frequent and the gross defects of the lumbosacral area found in the various sorts of spina bifida are readily shown by roentgenograms. They may show spondylolisthesis, which may be caused in the infant by difficult delivery and spondylolisthesis in the mother may cause such difficulty in delivery. Lumbosacral lesions associated with general diseases of the skeleton may be shown by roentgen examination as well

as trauma and local disease of the lumbosacral area. Injuries of this region may cause inflammatory conditions which already existed in a latent state, such as tuberculosis, syphilis and new-growths to become manifest. Lesions of the intervertebral discs and protrusions from the discs into the spinal canal may be shown by roentgen examination. When this was first discovered many surgeons thought this was the sole cause of low back pain and that it could be remedied by operation; such of course did not prove to be the case; moreover operation on the disc may cause other injuries to such an extent that the State Corporation Insurance Fund of California reports compensable disability in 100 per cent of patients operated on for disc injuries. Their report emphasizes the importance of thorough investigation of the cause of the injury, particularly the continuation of pain following it, and of any hysterical element in the case before resorting to drastic surgery.—*Audrey G. Morgan.*

Lagomarsino, Enrique H. El granuloma lipofágico de la rodilla. (Lipophagic granuloma of the knee.) *Rev. ortop. y traumatol.*, July, 1944, *14*, 43–55.

Recently Max Biedl published a series of articles in the *Arch. f. klin. Chir.* in which he described what he calls lipophagic granuloma of the knee, differentiating it from the various pictures of lipoid disease. The author has recently seen a case which belongs to this group of lipoid granulomas and describes it in detail, illustrating it with photographs, roentgenograms and photomicrographs of the histopathological findings.

The patient was a man of forty-five who in 1935 fractured his right knee. Complete recovery followed operation. In June, 1937, he fractured the left knee and this, too, apparently recovered completely after operation. But in five or six months the knee began to swell; it improved on diathermy but the swelling recurred several times, and when he came to the author he presented the swollen condition of the left knee joint seen in the photographs.

In addition to the pasty swelling of the joint, palpation showed two tumors the size of dove's eggs. Operation under local anesthesia showed a wine-red tumor tissue between the aponeurosis and the synovial plane which was dotted with large yellow spots. Histopathological examination showed it was granulation tissue very rich in cells of a xanthomatous type, and containing sudanophil granulations. The cavity was curetted and the patient given roentgen therapy, a total dose of 2,000 r being given in two weeks. He made an uneventful recovery and when seen a year later there was no recurrence.

Polarimetric examination is a good means of deciding whether a disease of the knee joint is a simple lipoid process or a lipophagic one. If the foam cells are birefringent, it is a true lipomatous process while if they are not it is a lipophagic disease. Unfortunately, this examination could not be made in this case.

Biedl's 2 cases are reviewed. Trauma with intratissular hemorrhage is probably a factor in the production of this disease; histological examination indicates that the lipophagic cells are reticuloendothelial in origin. The hemosiderin pigment found in this case is in agreement with the observation of Harbitz who found this pigment in all of 37 cases of lipophagic granuloma examined.—*Audrey G. Morgan.*

Lyford, John III, Scott, Roger B., and Johnson, Robert W., Jr. Polyarticular arthritis and osteomyelitis due to granuloma inguinale. *Am. J. Syph., Gonor. & Ven. Dis.*, Sept., 1944, *28*, 588–610.

Extragenital granuloma inguinale is not often reported, and bone and joint lesions of the disease are rare. Lyford, Scott and Johnson report 3 proved cases of polyarticular arthritis and osteomyelitis in Negroes, 1 of which had disseminated bone and joint lesions and 2 cases had osteomyelitis in addition to soft tissue lesions. In the one, involvement of the right elbow with eventual lesions in both ankles, hands, wrists, the other elbow, skull, clavicle and acromion process was present. Roentgen examination revealed a diffuse osteolytic type of lesion with absence of sequestration and involucrum. Death occurred and final studies had not been completed at the time of the report. A second case had lesions in the third and fourth lumbar bodies and left hip. No cure had taken place at the time of the report. The third case had a lesion progressing from the hand to the radius requiring amputation of the arm with apparent cure. Biopsy from all 3 cases showed granulation tissue, plasma cells and macrophages containing Donovan bodies. Pathologically the bone lesions revealed no pus but granulation tissue. The possibility that the

disease is systemic is suggested with hematogeneous spread.—*Leo A. Nash.*

Marottoli, Oscar R., and Celoria, Francisco. Osteomielitis crónicas a forma seudotumoral. (Chronic osteomyelitis of the pseudotumoral form.) *Rev. ortop. y traumatol.*, July, 1944, *14*, 3–22.

The authors describe 6 cases of this disease and illustrate them with roentgenograms. The patients all recovered after operation. The special importance of this condition lies in the fact that it is often mistakenly diagnosed as bone sarcoma, while as a matter of fact it is only an attenuated form of osteomyelitis.

It differs from other forms of chronic osteomyelitis only in its tendency to form tumors, generally of the diaphyses of the long bones, particularly the femur and tibia; pressure of the tumor on the soft parts may be so great as to cause ulceration of the skin. The hyperostosis of bone originates from the cortex and it encroaches on and may completely obliterate the marrow cavity. Sometimes the tumor takes the form of an onion with concentric layers of bone. There may be cavities in the new-formed bone containing sequestra or a gelatinous or albuminous mass representing the marrow. The microscopic lesions are pure condensation with decreased numbers and size of the haversian canals. The causative agent is generally the *Staphylococcus albus* or *aureus* but sometimes no bacteria can be found. The most characteristic clinical symptom is pain which may vary greatly in degree. Generally the regional glands are not enlarged. The blood changes are only those of general infection but the sedimentation rate is always increased. Alkaline phosphates are not increased, which is a point in differentiation from osteogenetic sarcomas. In sarcoma, too, the pain is generally more intense and persistent and the temperature higher; the soft parts are more involved and the general health is more seriously affected; the roentgenogram shows a more irregular border in sarcoma than in osteomyelitis; sarcoma may cause an onion form of tumor but it is not so large or so regular in form as that of osteomyelitis.

Roentgen examination in these pseudotumoral forms of osteomyelitis shows a thickening of the bone cortex of the eburnated form which is very opaque so that no trabeculation shows. The new-formed bone is cylindrical or fusiform with regular outlines.

Treatment is surgical, a free incision being made, the excess bone removed and drainage established. This treatment generally results in recovery.—*Audrey G. Morgan.*

Garavano, Pedro H., and Schajowicz, Fritz. Mixoma oseo. (Myxoma of bone.) *Rev. ortop. y traumatol.*, July, 1944, *14*, 56–62.

The patient, a man of thirty-six, came for examination in April, 1940; he had had a sharp pain in the posterior part of the right elbow for about a year which increased on pressure with the fingers. Recently swelling had appeared at this site. There was a tumor with a smooth surface in the right olecranon region; it was the size of a hen's egg and hard as bone except at one point at the tip of the olecranon. There were no enlarged epitrochlear or axillary glands. Extension and flexion of the elbow were normal. Roentgen examination showed a tumor of the geodic type, transparent and cystic, which had invaded all the upper epiphysis of the ulna and extended downward 8 or 9 cm. into the diaphysis, occluding the marrow cavity. It was surrounded by a thin shell of bone and showed no periosteal reaction. The joint lumen was preserved though the tumor extended to it. Operation on May 24, 1940, showed a lobulated mass of grayish color with a distinct plane of cleavage from the superficial tissues so that it could be removed in its entirety, using a spatula as a wedge. The cavity was curetted and hemostasis brought about by filling it with tampons wet with warm physiological salt solution. A graft from the tibia was inserted into the defect in the bone. A cast was applied with the elbow at a right angle. Recovery was uneventful.

Microscopic examination showed that the tumor was a pure myxoma without the giant cells characteristic of the tumor described by Ewing. Some zones were very rich in cells but there were no signs of malignancy. Roentgen examination five months after the operation showed that the graft had taken perfectly and movements of extension and flexion of the elbow were complete.—*Audrey G. Morgan.*

Molina, Vicente A. Síndrome de Volkmann; estado actual de su tratamiento. (Volkmann's syndrome; present status of treatment.) *Rev. ortop. y traumatol.*, Jan., 1944, *13*, 174–189.

Volkmann's ischemic contracture is a serious complication, fortunately not very frequent, of

severe injury of the limbs, with or without fracture, commonest in the upper limbs. Most of the patients are children and it is particularly frequent in patients with supracondylar fracture. The exact cause of the condition is not known but it is certain that circulatory disturbances and irritative lesions of the periarterial sympathetic nervous system are factors in its causation. Sometimes it is brought about by injuries of the nerves during operation and sometimes by improperly adjusted plaster casts.

Treatment may be surgical, orthopedic and physiotherapeutic. Early operation in the beginning of the condition may prevent the development of the later more serious stages. Operations that may be performed at this time are aponeurotomy, periarterial sympathectomy and arteriectomy. Delayed operations some weeks after the beginning of the disease may improve the condition; these operations are sympathectomy, arteriectomy and treatment of the nerve lesions. Late operations can only partially correct the sequels of the disease; these are operations on the bones, muscles and tendons. Orthopedic treatment must be well chosen and prolonged.

Plaster casts should always be adjusted carefully and the patient watched so that if the slightest sign of contracture develops the cast may be removed and correction made. As the condition is sometimes caused by manipulations in reducing fractures these should always be carried out as gently and carefully as possible. —*Audrey G. Morgan.*

Garber, Robert L. Rhabdomyosarcoma of the extremities. *Radiology*, June, 1944, *42*, 595–596.

Rhabdomyoma occurs chiefly in the genitourinary tract, though some cases have been described in the extremities, chiefly the lower.

The only effective treatment is surgical removal and then they show a tendency to local recurrence. Leucutia reports a series of 3 cases of rhabdomyosarcoma, in a total of 3,000 cases of malignant tumor of all types, none of which was influenced by irradiation.

The author describes a case in a man of sixty-eight who for about six months had had pain in the left shoulder. When he came for examination there was a large firm mass at the upper end of the humerus, definite limitation of movement and constant pain. Roentgen examination showed a large, irregular area of destruction at the upper end of the humerus with bony spicules extending into the soft tissue mass. The appearance suggested primary osteogenic sarcoma. There was no evidence of metastasis. Roentgen treatment had no effect and the tumor was removed surgically. It was a large hemorrhagic tumor the size of a grape fruit involving the upper third of the humerus. A photomicrograph of a section is given. It shows cellular pleomorphism and many giant multinucleated cells, There were areas of degeneration, necrosis and hemorrhage. It apparently originated in skeletal muscle, making it a rhabdomyosarcoma.

The wound healed promptly; six months later the patient was in good general condition but movement of the arm was limited.—*Audrey G. Morgan.*

BLOOD AND LYMPH SYSTEM

Smith, Beverly C., and Quimby, Edith H. The use of radioactive sodium in studies of circulation in patients with peripheral vascular disease; preliminary report. *Surg., Gynec. & Obst.*, Aug., 1944, *79*, 142–147.

The viability of an extremity is dependent upon the arterial blood which reaches it through its main arteries or through their branches which constitute the collateral circulation. Prognosis and results of therapy in peripheral vascular disease could be more accurately judged if a simple objective method were available for measuring the arterial flow through these two circulations. Most of the available physiological tests are clinically impracticable. In searching for a practical procedure, it was decided that if radioactive sodium were injected intravenously at the antecubital fossa, its arrival in other parts of the body could be recorded by a Geiger-Müller counter and thus circulation time from arm to any desired region obtained. Since there is constant interchange of sodium between blood plasma and extravascular fluid, the amount of radioactive isotope will increase in any particular region until equilibrium is attained. This can be followed by the rate of response of the counter. The manner in which this equilibrium is built up may be related to the degree of pathological change in the vessels of the extremity.

In addition to normals, the following types of case have been studied: arteriosclerosis, with and without diabetes, peripheral thrombosis and embolus, thromboangiitis obliterans, sclero-

derma, Raynaud's disease, Raynaud's syndrome, aneurysm, frostbite, immersion foot, and essential hypertension. To date, approximately 60 patients have been studied.

The results obtained have been definite, objective, and uninfluenced by the observer, the environment, or the condition of the patient (except for his disease). Information obtained has supplemented clinical and laboratory methods, yielding valuable data concerning the patency of the main and collateral circulation. In particular, preoperative studies of patients coming to amputation have been valuable in confirming clinical impressions of competency of main or collateral circulation to permit healing below the knee joint.

There have been no untoward local or systemic reactions to the use of the radioactive isotope. Many of the patients observed have been ambulatory and have not required hospitalization for this study. The radioactive sodium is prepared in the cyclotron by bombarding sodium metaborate with deuterons. In the material finally obtained after treatment of the metaborate containing the active atoms, the radioactive isotope forms a very small percentage of all the sodium atoms present. In 5 cc. of normal saline containing 200 microcuries of radiosodium, fewer than 1 in 10 million sodium atoms are active; the rest are ordinary stable isotope. However, the ordinary and radioactive ones are indistinguishable and inseparable until the radioactive ones disintegrate. In the instant of disintegrating, the radioactive atoms emit B particles and y rays, and become atoms of stable magnesium. The amount of magnesium thus formed is entirely too small to have any demonstrable effect, being, for the quantities here cited, the order of a millionth of a microgram. The radiation detected by the Geiger-Müller tube and the recording apparatus gives an audible click for every disintegration (or every 2, 4, 8, 16, or 32 disintegrations according to a scaling adjustment). The amount of radiation the patient's body receives in the total disintegration of the amount under discussion is less than 1 roentgen. —*Mary Frances Vastine.*

Stock, Maurice F. Hereditary hemorrhagic telangiectasia (Osler's disease); review of the literature and report of cases. *Arch. Otolaryng.*, Aug., 1944, *40*, 108–114.

Hereditary hemorrhagic telangiectasia is a rare disease, probably due to mesenchymal dysplasia. It is characterized by the presence of multiple acquired angiomas or telangiectases of varying distribution and number with a marked tendency to bleed spontaneously or from slight trauma. The disease is transmitted as a dominant characteristic. The initial symptom usually consists of abnormally profuse epistaxis beginning about puberty. This is followed by the development of multiple telangiectasia of the skin and mucous membranes from the age of twenty-five to thirty-five years. Hemorrhage from the nasal mucosa is most frequent, and all symptoms tend to reach their greatest severity during the fourth decade. The average mortality rate is 4 per cent.

Macroscopic Picture. The lesions vary in color from red to purple and in size and form from pinpoint spots to the larger nodular forms and the large "spider form" or nevus araneus. They blanch on pressure, unless a hemorrhage has taken place recently. They are most commonly found in the nasal mucosa, the skin of the face, the buccal mucosa, the lips, the tongue, the floor of the mouth, the scalp, the ear, the conjunctivas and the finger tips. Other common sites are the ear drums, the palate, the pharynx, the larynx, the trachea, the esophagus, the stomach, the intestines, the bladder, the uterus and the urethra.

Microscopic Picture. The lesion usually shows an increased number of dilated vessels with greatly thinned walls. The tissues covering the vessels are usually thinned, which permits hemorrhage to occur from trivial causes. Thrombosis is frequent and probably explains the tendency of the lesions to disappear spontaneously, while new ones arise elsewhere.

Differential Diagnosis. In the differential diagnosis one must consider the telangiectases due to syphilis, senility, pregnancy and lead poisoning. The disease must also be differentiated from leukemia, aleukemia, aplastic anemia, thrombopenic purpura hemorrhagica, hemophilia, cirrhosis of the liver, cancer, persistent macular eruption, familial hemorrhagic purpura, Banti's, Gaucher's and Hodgkin's diseases and Sturge-Weber disease.

Treatment. This consists of various measures adopted to achieve immediate hemostasis, together with transfusions if necessary. Permanent cures have been reported following various types of cauterization and radiation therapy. It has been reported that the type 4 (Moss) blood group is intolerant of transfusions in the presence of splenohepatomegaly.

Hereditary Factor. In only a few instances has the disease been traced through six generations although there are numerous reports dealing with its transmission through three or four generations. This probably indicates self limitation of the hereditary transmission of the disease.

The disease is usually held to be hereditary, but it seems that at least 20 per cent of the recorded cases have lacked a family history of the occurrence of the disease and were not examples of atavism.

The author presents a review of the literature from 1933 to 1944 and adds 7 new case reports. —*Mary Frances Vastine.*

Mahorner, Howard. Control of pain in post-traumatic vascular disturbances. (Editorial.) *Surg., Gynec. & Obst.*, June, 1944, *78*, 657.

After trauma, complete recovery does not always follow in a reasonable time. In a large group of patients disability persists abnormally long in spite of physiotherapy and other means to obviate the remaining symptoms.

In 1915, Leriche performed a periarterial sympathectomy on a brachial artery for a vasomotor phenomenon associated with pain, cyanosis, and a cold extremity in a man who had had a bullet wound of the axilla. The burning pain was immediately relieved. This was a new approach to the relief of such pains. Since then, however, the rôle of the sympathetic nervous system in the post-traumatic syndrome has not been widely appreciated, and measures to affect the pain by attacks on the sympathetic nerves are not in common use. Perhaps there are two reasons why this has not been widely accepted. First, there is no experimental proof from the lower animals and, second, it is generally taught that pain travels over sensory nerves only.

The conditions included under this discussion are causalgia, sympathalgia, Sudeck's atrophy, vague pains not strictly deserving designation by any of these terms; and in addition, painfully stiff joints and ischemic contractures of the Volkmann type.—*Mary Frances Vastine.*

Samuel, Eric. Venography in primary axillary vein thrombosis. *Brit. J. Radiol.*, March, 1944, *17*, 83–85.

Little has been written about venography as a means of diagnosis of primary thrombosis of the axillary vein. Andersson in 1938 first used the uroselectan group of dyes in the diagnosis of this condition. Objection has been made to the use of radiopaque dyes for this purpose because they cause sclerosis, but in the 2 case in which the author used the method there was no further extension of the thrombosis.

He reports 1 case in a young soldier twenty-two years of age who was admitted to a military hospital complaining of painless swelling of the left arm which had persisted for two weeks. Twenty cubic centimeters of pyelectan solution were injected into the antecubital vein and films taken after 10 cc. had been injected, after the whole amount had been injected and one minute after the completion of the injection. The dye in the axillary vein could be followed as far as the outer border of the third rib where it stopped abruptly; beyond this a collateral venous circulation could be seen extending around the neck of the scapula. Normal and pathological venograms are given. It is probable that this condition is caused by trauma.—*Audrey G. Morgan.*

GENERAL

Toth, Benedict J. Accidental trauma and tumor metastasis. *Radiology*, June, 1944, *42*, 579–590.

There has been a great deal of argument as to whether trauma can cause tumor metastasis. In connection with this question 2 cases are presented. The first patient was a man of fifty-five. A part of a machine with which he was working fell on him and caused severe injuries of the right arm and a deep laceration of the lower part of the right thigh. Roentgenograms showed an oblique fracture of the radius about an inch above the joint surface. On reduction of the tumor a soft pedunculated tumor was found on the flexor surface of the left forearm, which was removed. A metastatic tumor developed in the right wrist, localized first in the subcutaneous tissues and gradually invading the bone. Other metastases developed and the primary tumor was finally found to be one of the larger nodules in the right lung close to the hilum. Because of the difficulty of determining whether the metastases were caused by the injury a slight injury was inflicted on the anterior surface of the right leg. When the patient died more than two months later, there was no evidence of metastasis at the site of this injury. A metastatic tumor from trauma should be at the site of the trauma.

The second case was in a man of sixty-four who fell from a roof striking his head on a platform. There was a fracture of the first lumbar

vertebra, and a small palpable mass in the epigastrium. About three months after the accident the patient died. Autopsy showed a fungating carcinoma of the stomach with metastases in the regional lymph nodes, the liver, various ribs, both clavicles and the sixth and seventh thoracic vertebrae, but none in the fractured first lumbar vertebra.

After a detailed discussion of the evidence the author concludes that it is unlikely that trauma causes tumor metastases. It has not been possible to produce metastatic tumors in mice and rats by fracturing their bones. The cases of assumed traumatic causation of metastases reported in the literature do not show satisfactory scientific evidence of a definite causal relationship.—*Audrey G. Morgan.*

Byron, Charles S., and Michalover, Saul. Calcinosis and scleroderma with parathyroidectomy. *Ann. Int. Med.*, Feb., 1943, *18*, 225–232.

A patient showing calcinosis universalis, scleroderma and sclerodactylia and muscle atrophy is presented. Studies of the calcium metabolism revealed no abnormality. The phosphorus metabolism study revealed a tendency toward a negative balance.

Roentgenography revealed the heart and lungs to be negative. Rarefaction of both humeri was noted. There was decreased thickness of the cortex and some cystic change in the upper half of the right cortex. There was thinning of the humeroscapular articulation. All the other bones appeared normal. Calcium deposits were seen in both hands, knees, particularly the left, over the right third, fourth and fifth metatarsals and the left fifth metatarsal. Larger deposits were evident in the subcutaneous tissues of the left elbow and the left knee. The bones and joints in the region were not involved. A large deposit of calcium was seen within the abdomen.

The pathogenesis is unknown. Two theories explaining the calcium deposits are generally held. The first implies a primary alteration in calcium metabolism and the second holds that calcium is deposited in previously degenerated connective tissue. Neither theory is conclusively demonstrated.

Ramsdell recently presented 4 patients with calcinosis universalis demonstrating rapid absorption of calcium deposits with improvement in the clinical picture following parathyroidectomy and hemithyroidectomy. Consequently a right hemithyroidectomy and parathyroidectomy was performed on this patient. The authors conclude that the operation had little influence on the clinical course and no effect on the calcium deposits.—*J. J. McCort.*

Moretz, William H. Malignant tumors arising from the synovial membrane with report of four cases. *Surg., Gynec. & Obst.*, Aug., 1944, *79*, 125–132.

There is increasing interest in malignant tumors arising from the synovial membrane although they are uncommon. The first work of importance on this group of tumors was done, in this country, by L. W. Smith in 1927.

Nomenclature. Various names have been applied to this group of tumors including synovioma, synovial sarcoma, spindle cell sarcoma, perithelioma, villous angiofibroma, synovial sarcoendothelioma, myxosarcoma, and synovial sarcomesothelioma.

Synovial tissue is encountered in the synovial membranes of joints, serous bursae, and tendon sheaths. It is generally agreed that synovial tissue arises from mesodermal tissue. The author feels that the term "malignant synovioma" is a fitting one since it does have anatomical significance and would separate this group of tumors from the benign tumors arising in the same location.

Incidence. The occurrence of these tumors is most frequent between the ages of twenty and forty years. About half the cases occur about the knee joint. Other areas commonly involved are the elbow, ankle, foot, thigh, and palm of hand. Both sexes are equally affected.

Precipitating Factors. Trauma has been reported in an appreciable percentage of these patients as having preceded the tumor but the relationship of trauma to the tumor growth is thought to be only incidental. The growths have been reported as occurring in areas which have previously been the site of chronic bursitis or synovitis.

Symptoms. In about half of the patients, pain is a prominent symptom and in about one-third of the patients, pain is the initial symptom.

Approximately 95 per cent of the patients have a noticeable tumor mass which is frequently tender. In some cases the swelling had been present for from six to ten years before operation while in others the tumor mass had been present for only a few months. The original rate of growth is usually very slow.

Anatomy. Grossly, the tumors may be firm or

soft. Some are well circumscribed and some are not. They are usually grayish-white in cross section and very vascular.

Microscopically, these tumors are differentiated into two types. The first type apparently arises from the outer, more dense layers of the synovial tissue and is usually indistinguishable from the common fibrosarcoma. The second type seems to arise more from the inner layer of the synovial tissue and is more epithelioid in character.

Prognosis. The prognosis is very unfavorable. Death is generally due to pulmonary metastases.

Treatment. Amputation is recommended unless really wide local excision is feasible.

The author presents 4 case histories bringing the number of reported cases of malignant synovioma to 82.—*Mary Frances Vastine.*

Slaughter, Danely P. The multiplicity of origin of malignant tumors; collective review. *Internat. Abstr. Surg.*, Aug., 1944, *79*, 89–98.

Our increasing knowledge of the behavior of malignant tumors has steadily cut down the taboos on recognition of second primaries. Multiple skin cancers are accepted by everyone as being independent tumors and not metastases from a single focus. Other combinations of cancers may be equally clear. For instance, a patient with squamous carcinoma of the upper esophagus and colloid carcinoma of the rectum is obviously a victim of two cancers and not a subject of transcendental metaplasia. In contrast to the many clear-cut instances of multiple primaries, however, there is a large number of situations in which decision may be very difficult. Patients with carcinoma of the stomach and ovary present the problem of differentiation between independent tumors and gastric carcinoma with Krukenberg tumors. Bilateral breast cancer is another situation that may be very confusing. Since cutaneous metastases to the opposite breast, particularly in the form of carcinoma "en cuirasse," are so well known, parenchymal metastases are considered to be equally possible. Whether or not this is questionable, those patients who are first seen with simultaneous bilateral breast lesions, each resembling primary tumors, and without intervening cutaneous metastases, may be reasonably considered to present multiple primary tumors. Likewise, when a patient develops a lesion in the remaining breast from one to fifteen years after removal of the other gland because of cancer, with no evidence of recurrence of the previous lesion, and if the second appears in all respects as a typical primary breast cancer, this second tumor should be considered a new focus of neoplastic disease, and not a cellular descendant of the first lesion. This is not to say that such tumors are unrelated, because they probably are, from the standpoint of etiology.

Discussion. It seems apparent that cancer does not arise as an isolated cellular phenomenon, but rather as an anaplastic tendency involving many cells at once. Ewing remarks that in many tumors one can demonstrate cellular change toward the "precancerous" and preinvasive anaplastic cytological picture in areas outside of the limits of the frankly invading carcinoma. It is reasonable to assume that such areas of cellular change may occur at more widely separated points in an organ, and thus produce multiple tumors separated by areas of normal tissue.

That many neoplastic diseases are of multiple origin is fairly generally accepted. Such lesions as the lymphomas, multiple myelomas and Kaposi's disease commonly occur as multiple tumors. We have not been accustomed to think of the other, usually single, neoplastic lesions as being of this type, however. Yet the common finding of multiple skin cancers, and the listed cases of multiple tumors of the colon and breast show that even these lesions have such a tendency. It suggests that the etiological factor, whatever it may be, acts on all the tissues of one type, and may produce multiple anaplastic lesions of the mucosa of the colon, for example, or the epithelial lining of the urinary bladder. On the other hand, the multiple tumors that occur in different organs suggest a tumor diathesis in the individual, certainly a greater degree of susceptibility than can be explained away as mere coincidence or accident.

Heredity may play a part in the occurrence of these multiple tumors. Whatever the etiological background of multiple tumors may be, it seems definitely established that they occur more frequently than could be expected on the basis of chance alone.—*Mary Frances Vastine.*

Donaldson, Samuel W. Medical facts that can or cannot be proved by roentgen-ray; historical review and present possibilities. *Ann. Int. Med.*, April, 1943, *18*, 535–550.

Although it may be said that finished roentray films properly termed rotengenograms are

merely celluloid records and that roentgen-ray machines are merely so much metal and oil and rubber, the essential element of medical roentgenology is the physician specialist. It is he who makes the examination, who directs the technical procedures and subsequently interprets the shadows on the finished photographic film. Those physicians and laymen who regard a piece of equipment as the answer to any given technical problem are laboring under a false impression.

Every court in the land is clogged by numerous personal injury cases and the state compensation commissions are always burdened with cases awaiting a hearing. Into these courts and before the labor commissioners there is a veritable parade of clients and their attorneys armed with roentgen-ray films and accompanying them are those who are willing, per se, to testify to the irrefutable evidence presented by the roentgen ray, irrespective of the number or diagnostic quality of the roentgenograms. Even the best trained roentgenologist cannot be expected to arrive at a satisfactory conclusion when he is confronted with an insufficient number of roentgenograms of poor diagnostic quality. Although the courts are willing to accept properly authenticated roentgenograms in evidence as pictures they do not, it seems, ask the question, a picture of what? It should be apparent that having such a picture made and interpreted by someone qualified to do so is of the utmost importance. The author then discusses the possibilities and limitations of diagnosis by the roentgen ray. This subject is considered under the following headings according to their anatomical location: head, teeth and jaws; eye, nose and throat; chest; heart and aorta; abdomen; circulatory system; bones and joints; genitourinary system; cerebronervous system; gastrointestinal system and miscellaneous.

The article is concluded by the prediction that, taking into consideration the rapid advances made by the roentgen ray in the past, one cannot not be optimistic about the many possibilities for diagnosis that this branch of medicine may produce in the near future. The use of the electron microscope and the development of radioactive substances by the cyclotron are expected to play an important part in this future.—*J. J. McCort.*

ROENTGEN AND RADIUM THERAPY

Souttar, H. S. The Mackenzie Davidson lecture; team work in the treatment of cancer. *Brit. J. Radiol.*, Aug., 1944, *17*, 229–234.

Mackenzie Davidson was one of the great pioneers in British Radiology, his chief work being in methods of localization; he elaborated stereosopic methods which are still fundamental in roentgen localization. The lecturer emphasizes the importance of such pioneer work and also shows the value of building on it in order to establish team work among several specialists in the fight on cancer. He himself is a surgeon and perhaps understands best the surgeon's point of view. He believes the surgeon should have the first responsibility in diagnosis and determining the extent and stage of the tumor and that he must understand clearly the possibilities and danger of its removal. So far carcinomata of the stomach and large intestine have been considered purely surgical but he describes 2 cases in which he used radium with such good results, even though they were temporary, that he thinks it may in future be possible to treat these tumors by radiation when better methods of application have been worked out. Bold surgery is also indicated in cases in which there is involvement of bone in buccal carcinoma. Two illustrative cases are described.

The choice between irradiation and surgery is more debatable in operable carcinoma of the tongue. He himself prefers surgical removal of the primary growth and irradiation of the glands. In carcinoma of the breast he prefers surgical removal and is opposed to routine irradiation after removal of an early carcinoma. The surgeon can also make a valuable contribution by providing access to closed tumors, such as those of the lower half of the esophagus. Tumors of other intrathoracic structures, such as the root of the lung may be dealt with in the same way. Full opening of the thorax, which has been made possible by intratracheal anesthesia, has great possibilities. The thorax may also be opened by longitudinal splitting of the sternum. Surgical access is also valuable in tumors of the brain. The success of the Chaoul apparatus in treating epithelioma of the lip has suggested that it might be used with equal success in other regions if they could be rendered accessible. It is not difficult for example to expose the ampulla of the rectum for treatment.

The surgeon may also have to complete a cure almost accomplished by irradiation. A remnant of tumor at the base of the tongue may

persist. An ideal exposure of the base of the tongue can be accomplished by dividing the jaw by Syme's operation.

The radiotherapist must have an exhaustive knowledge of the effect of irradiation on normal and pathological tissue. While surgeon and radiologist must depend on each other they must both depend on the physicist who made radiotherapy possible and who must be depended upon for precise measurement of dosage and accuracy in obtaining a uniform field. Analysis of the results obtained by irradiation requires mathematical knowledge of a high order. Both physicist and dentist must aid in the construction of intrabuccal moulds for the application of radium. Increased voltage is one direction of physical advance and though the expense and the space required are both great, further work must be done with the million voltages for there is no telling to what they may lead. The lecturer favors the development of apparatus capable of delivering a large dose in a short time to a tumor exposed surgically.

A biochemist is also a necessary member of the team. The destructive effect of irradiation appears to be limited to the individual cell. It is possible that some substance may be elaborated in the body itself which will destroy the cancer cells.

The team once organized should act together and the individuals composing it be able to sink their individual preferences in favor of the wellbeing of the patient. It is suggested that all cases be considered by the team and their treatment be assigned to whatever field promises the longest length of survival and the best possible condition for the patient.—*Audrey G. Morgan.*

Simchowitz, H. C. German radiotherapy in 1942–1943. *Brit. J. Radiol.*, July, 1944, *17*, 216–217.

Since the beginning of the war the German publication *Strahlentherapie* has not reached England but the volumes for 1942 and 1943 have recently arrived. German radiotherapy has apparently been stagnating; there does not seem to be any advance in any particular field. Nearly all the papers with the exception of two from the Swiss Radiological Center at Zürich are rather conventional and show no familiarity with recent developments in the international literature. Most of the papers are by German and Austrian authors with a few by Hungarians and Swiss. There are none by Italians.

A brief summary of the main papers is given. An article by Zuppinger of Zürich on "The Second Course of Protracted-Fractionated X-ray Therapy is quite interesting.—*Audrey G. Morgan.*

Bush, F. The calculation of dosage rate in rectangular fields. *Brit. J. Radiol.*, Aug., 1944, *17*, 248–250.

The dosage rate at any point in a roentgen-ray field is made up of two factors, the primary radiation and the secondary radiation, Clarkson in 1941 showed how the dosage rate due to secondary radiation can be determined by dividing the field into a number of sectors, measuring these and adding the contributions of the different sectors. In the case of rectangular fields it is possible by using the principle of his method to construct a single set of curves from which, using the central depth dose data tabulated by Mayneord and Lamerton, the secondary radiation at nearly all points, in a field of any size and for any quality of radiation and focal skin distance, can be determined without the necessity of measuring sectors. This saves time if a number of points have to be calculated, as is the case when an isodose curve is to be constructed. The mathematical data on which the calculations are based are given and curves showing the results given. The method of plotting the isodose diagram is described.—*Audrey G. Morgan.*

Ungar, E. M., Spiegler, G., and Smithers, D. W. The volume localisation of deep-seated tumours by means of tomography. *Brit. J. Radiol.*, Aug., 1944, *17*, 235–238.

Since three-dimensional distribution of radiation has come into use it is important to know the volume of the tumor to be treated and its localization in relation to the surface of the body. Tomography, or sectional roentgenography, has proved of value in the localization and determination of the volume of tumors in various parts of the body. The technique of reconstruction of tumors by means of tomography is discussed, an apparatus for measuring the depth of tomographic planes described and the method of estimating the degree of magnification in each plane considered. Illustrations are given of tumors reconstructed by placing the redrawn tomograms in their correct relative positions in space. It must be remembered, however, that the use of tomography does not make it possible to dispense with straight roentgenograms. For instance, in a tumor in-

volving the antrum, posterior ethmoids and base of the skull, the main body of the tumor may be clearly seen on tomograms, but spread to the base of the skull may be missed if straight roentgenograms are not also considered. Tomography is merely an aid to accurate tumor localization and volume determination in some parts of the body and its value rests on the interpretation of the roentgenograms.—*Audrey G. Morgan.*

Morton, J., Gray, L. H., and Neary, G. J. Consideration of dose distributions in the treatment of intrinsic carcinoma of the larynx by radium implantation. *Brit. J. Radiol.*, July, 1944, *17*, 204–212.

This paper describes anatomical and physical studies of types of radium implantation used at the Radium Institute, Northwood, Middlesex. Illustrations of the distribution of the needles and their relationship to the anatomical structures of the larynx are given. Two methods were used, one that of Harmer and Finzi in which one ala of the thyroid cartilage was fenestrated and the other a modification of this method in which the lower border of the thyroid cartilage and the upper part of the cricoid ring were also removed. Doses of about 6,000 r were delivered in 168 hours with about 10 mg. of radium. The necessary intensity was obtained by placing the needles very close to the growth and in this way avoiding injury to the surrounding healthy tissues. Eighteen larynges of men and women were examined by anatomical dissection to get the average position of the radium needles with reference to the anatomical structures and in this way compute the dosage. In 1 case a male larynx was halved by median section, fenestrated and the dose distribution determined directly by means of a small ionization chamber. The results of the two methods were in agreement. The uniform irradiation of the length of the vocal fold by a distribution of vertical needles is described.

With the normal fenestration technique there is almost certainly inadequate irradiation of growths which involve the posterior part of the vocal folds. It is possible that this could be obviated by the use of special unequally loaded needles.—*Audrey G. Morgan.*

Howes, W. E., and Platau, M., Carcinoma of the larynx; review of treatment and end results of Brooklyn Cancer Institute. *Arch. Otolaryng.*, Aug., 1944, *40*, 133–138.

The most significant prognostic factor in any case of largyngeal carcinoma appears to be the exact site of origin of the lesion. The significance of this factor seems to be due to the fact that the supporting matrix beneath the mucosal surface of the vocal cords is made up of a dense fibrous connective tissue with little or no lymph drainage while the supporting structure beneath the epithelium of the extrinsic larynx is that of a loose areolar tissue rich in a lymph supply. In most cases an epithelial new growth arising in or about the larynx is squamous cell carcinoma. It has been stated that histopathologic structure is of minor importance in determining the radiosensitivity of laryngeal carcinomas. It is therefore more the character of the framework and the richness of the lymph drainage which affect most the progress and spread of these neoplasms. As a corollary, the rapidity of growth, the manner of spread, the prognosis and the modality of treatment vary markedly with lesions which arise within a few millimeters of each other.

The cases of all patients (numbering 77) with laryngeal carcinoma who were admitted to the Brooklyn Cancer Institute from 1934 through 1942 have been reviewed.

Sex Incidence. Only 3 of the entire series of patients were females. The high incidence in males suggests some possible intrinsic etiologic factor in testicular hormone. The increased prevalence of smoking among women has not, up to the present, altered the high proportion of cases of laryngeal and bronchial carcinoma in which the patients were of the male sex.

Age Incidence. The youngest patient in the series was thirty-eight years and the oldest eighty-one years of age. The average age for the whole group was 58.5 years.

Symptomatology. The earliest symptom of laryngeal cancer is usually a "husky voice." Ulceration limited to a vocal cord may not produce pain. The first indication of carcinoma arising in the extrinsic laryngeal structures may be dysphagia. This is probably due to the carcinoma's rapid permeation of the surrounding lymphatics. Enlargement of cervical lymph nodes is common in patients who present themselves with a primary cancer arising in the vicinity of the vocal cord.

In spite of the fact that the greater number of patients gave a history of hoarseness of less than one year, most of the lesions were far advanced when first examined at the Brooklyn Cancer Institute.

Classification. Carcinoma of the intrinsic larynx usually originates on the free edge of a vocal cord. It may occasionally arise on the ventricular bands or in the interarytenoid region. It is usually of the squamous type.

Carcinoma of the extrinsic larynx originates most frequently on the epiglottis, the aryepiglottic folds or the arytenoids, within a piriform sinus or along the posterior laryngeal wall. This carcinoma is also usually squamous cell in type. It metastasizes early into the cervical lymph nodes.

Treatment. When the carcinoma is localized, operation offers the greatest opportunity for cure. Lesions too advanced for excision are usually referred for radiation therapy. All patients receiving roentgen therapy at the Brooklyn Cancer Institute have been given a modified Coutard type of repeated daily doses. Fifty-four patients received this treatment. This number included those with intrinsic lesions too extensive for surgical management and practically all the patients with extrinsic lesions inasmuch as these growths are not amenable to surgical treatment at any stage.

Analysis of Results of Roentgen Treatment. Many of the patients were admitted in such an advanced state of disease that but small palliative doses of roentgen therapy were given in the hope of reducing edema or infection. Therefore, for the study of end results it was decided to subdivide these patients into two groups: (1) those who received 4,875 r or more to the tumor in one continuous cycle of not over seven weeks' duration, and (2) those who received any dose of roentgen radiation up to 4,875 r, obviously not a carcinogenic dose. According to this postulate, 43 patients received a so-called therapeutic dose. Twenty-four of these 43 patients are listed as having a neoplasm that arose in the extrinsic larynx and 19, one that arose in the intrinsic larynx. Ten, or 23.25 per cent, of the 43 patients who received a so-called carcinogenic dose of roentgen therapy are living to date.—*Mary Frances Vastine.*

Phaneuf, Louis E. The management of uterine myomas; study based on 1000 consecutive personal cases and illustrating the technique of panhysterectomy. *Surg., Gynec. & Obst.*, Aug., 1944, *79*, 182–191.

Uterine myomas are tumors made up of smooth muscle and connective tisue in varying proportions and enveloped by a definite capsule of condensed muscle tissue from which they derive part of their blood supply. The smaller tumors which are not producing symptoms (the chief of these being hemorrhage and pressure) require no treatment. For those whose symptoms require treatment, two methods are available—surgery and irradiation. The author prefers surgery over irradiation and discusses the surgical aspect of treatment in some detail. In his discussion of irradiation, he observes that radium is superior to roentgen rays because only one treatment is usually necessary. Also, in treatment with radium, the radioactive substance is applied directly in the uterine canal so that the necessity of the rays traversing the abdominal wall in order to reach the uterus and ovaries is obviated. (He does not give the objections to the rays traversing the abdominal wall to reach the ovaries and uterus.)

The commonly accepted dose of radium for uterine myomas varies between 1,500 and 2,400 milligram-hours.

It should be an inviolate rule that a diagnostic curettage to rule out a malignant neoplasm of the endometrium must precede either method of irradiation. Certain classes of tumors constitute definite contraindications to this form of therapy, viz.,

1. Tumors larger than a three months' gestation.
2. Rapidly growing tumors suggesting progressive changes.
3. Tumors producing pressure symptoms.
4. Tumors associated with pelvic pain.
5. Pedunculated tumors in which irradiation tends to increase necrosis.
6. Tumors associated with adnexal pathology.
7. Tumors associated with cachexia.
8. Tumors in young women.
9. Multiple submucous tumors.
10. Tumors associated with pyometria.—*Mary Frances Vastine.*

Rashbaum, Maurice, and McIntosh, Harriet C. Pelvic actinomycosis treated by surgery and roentgen ray, with recovery. *Am. J. Obst. & Gynec.*, June, 1944, *47*, 849–854.

Actinomycotic infection of the internal genitalia of the female is uncommon and recovery is rare. Eighty-five cases of actinomycosis of the female pelvic organs have thus far been reported, of whom only 7 have survived. The authors report an additional case apparently cured of this malignant disease. Of the 7 cured cases already reported, 5 were treated by

surgery and roentgen irradiation, 1 by surgery and potassium iodide, and 1 by surgery, potassium iodide, roentgen and radium irradiation.

Summary of Case Report.

1. The clinical picture presented by this patient before operation was one of protracted, severe pelvic suppuration, with septic temperature, severe secondary anemia, and emaciation. Posterior colpotomy was performed on four occasions for the drainage of pus collections in the pelvis, with only temporary benefit.

2. Laparotomy was performed six and a half months after admission to the hospital, although the blood sedimentation rate was still very rapid. At operation, the findings resembled those commonly seen in cases of recurrent pelvic suppuration with tubo-ovarian abscesses.

3. In spite of hysterectomy and bilateral salpingo-oophorectomy, followed by large doses of potassium iodide, there was prompt recurrence in the abdomen. Roentgen treatment resulted in disappearance of the recurrences. The method employed, namely, surgery, followed by fractional roentgen treatment with high total dosage, is probably the most effective in the treatment of abdominal actinomycosis.

4. Follow-up examination, five and ten years later, disclosed that the patient was well and there was no evidence of abdominal or pelvic disease.—*Mary Frances Vastine.*

MISCELLANEOUS

Roberts, G. L. Observations on radiolucency as a significant physical property of the acrylic dental materials. *Brit. J. Radiol.*, July, 1944, *17*, 218–220.

Until comparatively recently vulcanite and metal have been the standard materials for making dental appliances. These were radiopaque. But recently dental materials of the methyl methacrylate type of plastics have been introduced for this purpose and their use rendered necessary by the withdrawal of rubber as a dental commodity. From the dental point of view this is an advantage as the technical methods of using these acrylic materials are simpler, they have a wider range of use than those formerly in use and the cosmetic results are better.

But from the point of view of the radiologist they have the disadvantage that they are radiolucent and show practically no shadow on the roentgenogram. In case of broken dentures and the presence of fragments in the body the roentgenologist should make sure of not giving a false negative report by familiarizing himself with the naked eye appearance of these materials and by questioning the patient's dentist as to whether the dentures were made of acrylic material and whether they included any porcelain teeth or metal bands which would show in the roentgenogram.

The radiolucency of this material is an advantage when it is used for the making of splints in jaw fractures. The old materials obscured parts lying beneath them and had to be removed in making a roentgen examination, but these can be left in place and a clear image obtained.—*Audrey G. Morgan.*

Hastings, W. H. Localisation of foreign bodies by a radiometric method. *Brit. J. Radiol.*, Oct., 1944, *17*, 316–318.

A roentgen method for determining the depth of foreign bodies is described which is absolutely accurate, does not require fluoroscopic examination and is quickly and easily carried out. The approximate localization of the foreign body is determined by a roentgenogram and a pin strapped to the surface of the skin above it. The tube is centered over the head of the pin, the focus of the tube being at a height of exactly 30 inches (76 cm.) above the film which is placed beneath the part. Two exposures are then made, one at a distance of $1\frac{1}{2}$ inches on one side of the pin and the other $1\frac{1}{2}$ inches on the other side, the total tube shift being 3 inches. These distances must be kept very accurately if the table of correction factors which is given is to be used.

Two diagrams and a roentgenogram are given which illustrate the application of the method. Only a minimum amount of calculation is required.—*Audrey G. Morgan.*

Medler, E. M., Pesquera, G. S., and Ordway, W. H. A comparison of roentgenograms with the pathology of experimental miliary pulmonary tuberculosis in the rabbit. *Am. Rev. Tuberc.*, July, 1944, *50*, 1–23.

Thoracic roentgenograms are indispensable in the study of pulmonary tuberculosis in man, particularly in the minimal stage of the disease and in the demonstration of lesion instability. Nevertheless, the limitations of the roentgenologic method must be understood. The chief concern to date has been the development of

apparatus and roentgenographic technique to yield comparable roentgenograms demonstrating the best film qualities. In order to circumvent the interference by denser thoracic structures, stereoroentgenograms, oblique, lateral and lordotic positions, spot films, fluoroscopy, and planigraphy have been utilized.

That tuberculous foci may exist in the lungs and not be visualized on satisfactory roentgenograms has not been appreciated generally. The authors have been unable to find reports in the literature of studies on man comparing chest roentgenograms with films of excised, inflated lungs and with the necropsy findings. A comparative study of the pathological findings and of roentgenograms of the thorax and of inflated excised lungs in experimentally produced miliary pulmonary tuberculosis in the rabbit is presented. Primary infection following inoculation with virulent and non-virulent bovine tubercle bacilli and re-infection with virulent bacilli in animals previously vaccinated with non-virulent organisms were studied.

The results revealed that the greatest numbers of lesions, as well as their essential pathology, were demonstrated on microscopic study; and, otherwise, macroscopic examination, roentgenograms of excised and inflated lungs and, lastly, thoracic roentgenograms were capable of demonstrating the pathological findings to a lesser degree and in the sequence mentioned.

By roentgen shadows alone, dense caseous, non-caseous, caseofibrotic and fibrotic areas could not be differentiated in the excised inflated lungs. Compact deposits of calcium were clearly demonstrable in caseous foci, but with lesser deposits, no differentiation between caseous material and calcium was possible. Likewise, superimposition of lesions produced a density on the roentgenogram which gave a false idea as to their size and nature; moreover, compactness, rather than size, is the most important factor governing the shadow characteristics. It seems that the compact portion of a lesion must be equal to the volume of a primary parenchymal lobule before a shadow will be cast on films of excised lungs. Actually, foci, when first observed in roentgenograms of the thorax are, in reality, considerably larger than the roentgen shadow would indicate because the loosely arranged peripheral inflammatory tissue is not radiopaque.

The authors suggest that it would be better practice if interpretations of intrathoracic shadows observed in chest roentgenograms were limited to descriptions of location, distribution and density. Pathologic interpretations, i.e., "fibrotic," "caseous," "productive," "exudated," etc., should be avoided.—*John R. Hannan.*

Beams, A.T., Free, A. H., and Leonards, J. R. Experimental hypoproteinemia and edema; studies of intestinal absorption and intestinal roentgenologic characteristics. *Arch. Int. Med.*, May, 1944, *73*, 397–402.

Using adult, female, mongrel dogs the authors produced hypoproteinemia with edema in 5 of the dogs by plasmapheresis. This procedure was repeated daily until the plasma proteins were depleted to a suitable level (2 to 3 gm. per 100 cu. cm.) and a definite edema could be demonstrated. The intestinal absorption of galactose and amino-acetic acid was studied by means of improved tolerance tests. This was done by the oral administration of the test substance by a stomach tube followed by the determination of the concentration of the substance in the blood after definite intervals of time. The type of curve obtained is an indicator of the degree of intestinal absorption. Since the blood concentrations are also affected by the rate of metabolism this is given consideration in the method. The presence of hypoproteinemia and edema had no significant effect on the rate of intestinal absorption of galactose and aminoacetic acid in this experiment.

Roentgenologic observations of the gastrointestinal tract were made after the oral administration of barium sulfate. Gastric emptying and intestinal motility were not altered by hypoproteinemia and edema. Some of the roentgenograms of the small intestine during edema showed moderate clumping of the barium and fragmentation. These phenomena were also noted in the studies on normal animals, although they occurred less frequently.—*J. J. McCort.*

Simendinger, E. A. Thyroid function as a factor in gall-bladder disease and formation of gall stones. *Surg., Gynec. & Obst.*, July, 1944, *79*, 10–20.

This study of gallbladder disease was undertaken to attack the problem as one of both a local and systemic nature, associated with a disease which affects the body function generally, namely, hypothyroidism. Numerous authors have shown that mild degrees of hypothyroid-

ism are frequently associated with gastrointestinal symptoms commonly seen in cholecystitis. J. W. Hinton reviewed 43 cases of hypothyroidism which presented the typical symptoms of peptic ulcer. Riegel, Ravdin, and Morrison noted that thyroid disorders are frequently associated with gallbladder disease.

It is of more than passing interest that all gallstones contain cholesterol. A high blood cholesterol level is found in both gallbladder disease and hypothyroidism. In fact, many authors believe that the blood cholesterol level is a more accurate index of thyroid function than the basal metabolic rate. Both hypothyroidism and cholecystitis are much more common in females and both diseases are associated with obesity.

In the author's clinic 36 per cent of patients with chronic gallbladder disease showed basal metabolic rates of −10 per cent or below, and and an additional 40 per cent showed a basal metabolic rate from 0 to −10 per cent. Only 24 per cent showed a positive metabolic rate. The author believes that these figures show that there is a definite trend toward hypothyroidism in the patients with chronic gallbladder disease.

Results of Experimental Studies.

1. A sustained elevation of the blood cholesterol occurred in thyroidectomized dogs, appearing about twenty-seven to thirty days following operation.

2. A prolonged high blood cholesterol level (two months or more) resulted in no increase in cholesterol output in the hepatic bile.

3. The hepatic bile salt content and total biliary output were somewhat low in these thyroidectomized animals as compared to the normal.

4. Gallbladder bile aspirated from the gallbladders of hypothyroid dogs showed a normal bile salt and cholesterol content in spite of the fact that an elevated blood cholesterol existed.

5. Gallbladder walls in hypothyroid dogs were studied microscopically and clinically for cholesterol deposit within them and no significant difference from the normal was found.

6. When the abdomens of the hypothyroid animals were first opened, the gallbladders of almost all the hypothyroid animals were greatly distended and contained much thick brown precipitate.

7. Several dogs were thyroidectomized and cholecystograms were made. The gallbladders of the experimental animals either failed to visualize, or, after visualization, showed a prolonged emptying time as compared to the normal.

Conclusions.

1. The hypothyroid state does materially affect gallbladder function. The large quantity of debris and concretions found, plus the roentgen findings, indicate that a marked degree of stasis takes place within the gallbladder.

2. Apparently a high blood cholesterol, as indicated by the hypothyroid state, does not result in an increase in the cholesterol content of the hepatic bile, nor does it result in a deposit of cholesterol within the gallbladder walls.

3. Obviously, infection plays a major part in the production of cholecystitis and cholelithiasis. However, any constitutional disease which impairs gallbladder function would certainly render the organ more liable to bacterial invasion and would be a factor to consider in the ultimate production of chronic cholecystitis.

4. Heavy precipitate and pigment concretions as seen in these hypothyroid dogs might easily be nidi about which stones might form if infection were superimposed upon the condition already present. In view of this, the hypothyroid state merits consideration as a contributing cause of cholecystitis and cholelithiasis and should be borne in mind when these patients are seen.—*Mary Frances Vastine.*

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